Wm R. Mason

Syracuse.

January 1898.

PLATE I.

FERN EVOLUTION
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BRITISH FERNS:

THEIR VARIETIES AND CULTURE.

BY

CHARLES T. DRUERY, F.L.S.

WITH ILLUSTRATIONS OF ABOUT 120 SELECT FORMS.

LONDON:
L. UPCOTT GILL, 170, STRAND, W.C.

1888.

LONDON:

PRINTED BY ALFRED BRADLEY, 170, STRAND W.C.

37.3
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Bot.

CONTENTS.

CHAP. PAGE

INTRODUCTION - - - - - - - - - 1

I.—COLLECTION AND CULTIVATION OF BRITISH FERNS.

I. FERNS AND FERN-HUNTING: WHERE TO SEEK AND HOW TO KNOW THEM - - 7

II. ON VARIATION GENERALLY - - - - - 17

III. FERN CULTURE AND PROPAGATION - - 27

IV. THE WONDERS OF THE SPORE - - - 34

V. FERN POTS, PANS, AND CONTRIVANCES, ROCKWORK, ETC. - - - - - - 45

VI. FERNERIES, WARDIAN CASES, ETC. - - - 56

VII. FERN FOES, AND HOW TO FIGHT THEM - 61

II.—THE FERN FAMILIES OF BRITAIN.

I. INTRODUCTION - - - - - - - - 69

II. THE MAIDENHAIR FERN - - - - - - 71

III. THE PARSLEY FERN - - - - - - - 73

CHAP.		PAGE
IV.	The Spleenworts	76
V.	The Ceterach	84
VI.	The Lady Fern	85
VII.	The Hard Fern	93
VIII.	The Adderstongue and the Moonwort	98
IX.	The Bladder Ferns	100
X.	The Small-leaved Gymnogram	102
XI.	The Buckler Ferns	104
XII.	The Royal Fern	113
XIII.	The Polypodies	116
XIV.	The Shield Ferns	124
XV.	The Common Brake	132
XVI.	The Hartstongue	135
XVII.	The Woodsias	144
XVIII.	The Filmy Ferns	145

Appendix—"Aposporv" 149

Index 161

CHOICE BRITISH FERNS:

THEIR VARIETIES AND CULTURE.

INTRODUCTION.

TO those who have taken up the study of our native Ferns, and have thus been enabled to form a just opinion of the wealth of beautiful types into which our comparatively few British species have sported, either under natural conditions or under cultivation, it is a matter of surprise, and even bewilderment, that popularly they should be so little known and so rarely cultivated. This ignorance has been in no small degree shared apparently by popular writers on the subject, since in all but two or three works the varieties are relegated to an entirely subordinate place, while in some they are actually not even alluded to, though repeated editions have been issued ostensibly extending the field of view. What should we think of a much-bepuffed Rose-book, or series of Rose-books, professing by their titles to exhaust the subject, while confining themselves exclusively to wild Roses, and never even distantly alluding to the glorious array of Maréchal Niels, Gloire de Dijons, and the thousand-and-one other rivals to the throne

of the Queen of Flowers? Yet this is precisely what has been done in the case of our lovely Ferns; and hence our wonder must logically be transferred from the ignorance of the public to that of its self-elected teachers.

Some thirty or so years ago, the many varieties then existing had a full share of popular interest, and became indeed the "rage," any new form, no matter whether really beautiful or simply odd, and possibly ugly, finding an eager welcome at the hands of numerous collectors. The inevitable result of indiscriminate collection in an ever-widening field was a surfeit, and a reaction in the shape of such neglect that at the present moment very few indeed, even among horticulturists, have the slightest idea of the many forms of delicate beauty which have been maintained and increased by the handful of specialists in whom the taste has survived. These, here and there about the country, have cherished all the best varieties known at the period indicated, and, by persistent search and selective propagation, added innumerable forms thereto, many of which infinitely transcend any hitherto described or figured. Moore's "Nature-printed Ferns" and Lowe's "Our Native Ferns" are the only works which give an adequate idea of the wonderful range of form which Dame Nature has contrived to produce from the few simple normal types of Ferns indigenous to Britain. Since their publication, however, as we have said, many forms, on an ever-increasing scale of beauty, have been either found wild or raised; and it is the object of this work to bring the record of these as far as practicable up to date.

As the popular taste is largely created by those who cater for it, the proper display of a good thing being generally the needful preliminary to the demand for it, to nurserymen generally must be imputed much of the blame attached to the neglect of these beautiful plants, well-grown specimens of which are very rarely displayed for sale, though exotic Ferns, with far less pretensions to beauty, are grown with the utmost care, and shown by the thousand. An idea, indeed, seems to have arisen that British Ferns are "common," and only fit for stopgaps in out-of-the-way corners where nothing else

will grow. Be it our task to dispel this illusion, and reinstate them in their proper place, *i.e.*, in the foremost rank of the delicate and charming class of foliage plants.

This we purpose attempting by describing and illustrating as simply and clearly as possible a number of the most beautiful and striking forms at present existing, omitting all those which, curious as they may be, can only be classed as imperfect plants. In our selection, we have been guided throughout by our own personal acquaintance with the plants described, nearly all of which we have ourselves either cultivated, raised, or, it may be, found. Our remarks on culture are also based on practical personal study and experience, and may therefore be relied upon.

To the inevitable objection which experienced Fern-lovers will raise, that there are many important omissions in the list of Ferns selected, we may point out, firstly, that in a designedly popular work of this class, a limited choice, covering as nearly as may be the most marked types, will give a clearer mental picture than if many intermediate forms linked them together; and, secondly, that since in one collection alone, near London, between *three and four thousand* distinct varieties exist, it is manifest that a popular price would preclude anything like an exhaustive list.

Scientific terms have been avoided as much as possible, as well as the strictly botanical classification of the genera. The normal or common forms are described and figured so as to permit their easy recognition; but, beautiful as they are, most of them have been so far outshone by the exceptional forms to which they have from time to time given birth, that the majority only find a place in these pages by way of contrast, and because acquaintance with them is necessarily the first step in the education of the eye in the search for and true appreciation of their more charming offspring. In this connection, we would direct attention to the fact that the representative varieties of our British Ferns at Kew have of late been materially enriched and extended by contributions and bequests from some of the best and choicest collections in the country. To such an extent, indeed, has this been done

that the bulk of the most marked and beautiful types may now be seen there in perfection, a new range of rockwork having been specially devoted to them, and constructed in such a manner as to afford the various species congenial homes, while, at the same time, every trace of obtrusive artificiality has been skilfully avoided. We are sanguine that our large public parks may follow this good example, by devoting some portions of rockwork in their many suitable nooks and corners to good specimens of these interesting plants. This has already been done at West Ham Park with wonderfully good effect.

In conclusion, we have to express our hearty thanks to Col. A. M. Jones, of Clifton, for permission to use his splendid series of Nature Prints of our British Ferns; to Mr. F. W. Stansfield, of Sale, for the loan of same and much valuable information in connection with our subject; and also to Dr. Masters, for permission to utilise, in the opening chapters, a series of articles which had already appeared in the *Gardeners' Chronicle*.

COLLECTION AND CULTIVATION

OF

BRITISH FERNS.

CHAPTER I.

FERNS AND FERN-HUNTING: WHERE TO SEEK AND HOW TO KNOW THEM.

FERNS (*Filices*) and their near relations the Mosses (*Lycopods*) and Marestails (*Equiseta*) have come down to us from a period of the world's history when flowering plants had probably not even commenced to appear—that first essential of floral existence, bright sunshine, being shut off from the earth's surface by a more or less dense and constant veil of cloudy vapour, floating in an atmosphere of probably tropical temperature. We have, indeed, to go back at least as far as the very earliest coal measures, in which we find the evidence of this in the shape of the veritable Fern fronds themselves, which, with their allies aforesaid, and others now extinct, grew in rank luxuriance, and have been transformed by time, heat, and pressure, into the very dissimilar lumps of black, shiny Wallsend, steam, or other coal which adds so materially in these latter days to our comfort and convenience. In the Coal Exchange, London, some very fine specimens of Fossil Ferns are exhibited, which, though of species peculiar to the age they lived in, resemble exactly their existing descendants in all essential characteristics.

In considering, therefore, the economic value of Ferns, which is usually regarded as almost *nil*, we must place to their credit, not only a fair share of the advantages we derive from coal, but also of that wonderful and ever-increasing store of coal-tar products, in the shape of aniline dyes, of all the hues of the rainbow, and a few more to boot; of marvellous drugs, with their no less marvellous names (benzylidenmethylketol, for instance); and last, not least, the future delight of all rising generations, Saccharine, in every grain of which dwells the sweetness of a hundred lollipops. In view of this enormous contribution to the delights of the eye and the palate, we can afford to ignore the half-apologetic ascription to our Ferns of a certain straw-like utility for packing purposes, and certain medicinal virtues of a very dubious nature and questionable value.

Now, since the Ferns of the present day resemble those of the past not merely in structure but in their nature generally, we gather from the foregoing, as our first lesson regarding them, that a moist atmosphere and plenty of shade are the first essentials of their existence, and that, as they do not bear flowers, and yet have perpetuated themselves, they must be reproduced in some other way. The first fact gives us at once a clue as to the most likely places in which to find them, *i.e.*, locally, in damp, shady woods, lanes, and glens, and generally in those parts of the world either where the rainfall is greatest, or where, owing to considerable elevation, a cloudy condition of the atmosphere exists. Hence, as far as Britain is concerned, we find the most congenial conditions to exist all along the west or south-west coasts, where Ferns are abundant, their numbers decreasing gradually, exactly as we might have anticipated, as we approach the east coasts, precisely in the same ratio as the winds become drained of the moisture they have gathered in their passage across the Atlantic.

The next thing to learn, after knowing where to find Ferns, is how to distinguish them from other plants not in flower, and here the second fact above cited, regarding their reproduction, comes in, and will aid us, in a general way, in their

recognition. The difference between Ferns and Flowering Plants consists, then, in the former bearing, instead of flowers, and eventually seeds, small, brownish or yellow patches upon the back of their fronds, which consist of innumerable spores, contained in microscopically small, stalked pods or capsules; and it is according to the character of these patches that botanists have divided the species, as well as they could, from one another. Without entering very deeply into technicalities, we will give a few hints for guidance in this direction.

These patches are sometimes round and uncovered, as in the Polypody (*Polypodium vulgare*); covered with a round or kidney-shaped scale, as in the Shield Ferns (*Polystichum**) and Buckler Ferns (*Lastrea*†). They may form a margin all round the divisions of the frond, as in the Bracken (*Pteris aquilina*); appear in large, sausage-shaped masses, an inch in length, as in the Hartstongue (*Scolopendrium vulgare*); or in several other ways, which will be described later on, in connection with each species, enough having now been said to give the student the clue to their general recognition, and to enable him to know one special characteristic of a Fern, by which mature plants may infallibly be discriminated.

Young Ferns, or full-grown barren ones, need some other distinctive feature, and we find this in another character—viz., that the frond of a Fern develops by a process of *uncoiling* itself, it and all its divisions, in their early stages, being coiled up upon themselves like a watch-spring—a peculiarity shared by so few other plants that the exceptions may be ignored, while the only exceptions to the rule among our British Ferns are the Adderstongue (*Ophioglossum vulgatum*) and Moonwort (*Botrychium Lunaria*), in which the fronds are straight at all periods of growth.

These are the two most obvious differences between Ferns and other plants, and should be sufficient to enable the beginner to be sure of his ground so far; the descriptions in the ensuing chapters of the various species will enable him

* Syn. *Aspidium.* † Syn. *Nephrodium.*

to tell one from another with tolerable certainty. This done, his attention will be directed to the many kinds of variation to which the common or normal species are subject; and, this stage attained, we may safely consider him a convert, and leave the charms of the Ferns themselves, and the possible triumph of good "finds," to put the finishing touch and make him an enthusiast.

Since the true Fern-lover who has any leisure at his command, is sure, sooner or later, to become also a Fern-hunter, we will proceed to give a few hints and suggestions, based on our own personal experiences, with the object of aiding him in his quest. When we write "him" or "his," we must beg our lady readers to transmute the pronouns to suit themselves, since we are indebted for many of the most remarkable finds to the sharp eyes of the ladies, and trust, therefore, to make fully as many disciples amongst the fair as amongst the (so-called) sterner sex.

The majority of the most striking varieties, either curious or beautiful, having been found growing wild, and the number of these being by no means small, it is manifest that an additional zest is given to the quest for Ferns, which is usually confined to a search for species only, if this fact be remembered, and additional care be bestowed upon the examination of the plants. The discovery, after long search, of a rare species in a new locality is very gratifying, but does not add anything more than a new name to the catalogue of the local flora; but the discovery of a new and unique form, possibly of great beauty, possibly only curious, adds something new to the flora of the world. This possibility is in the power of every Fern-lover who cares, in the first place, to familiarise himself with the aspect of the normal forms, so that he can recognise them at a glance, and then to educate his eye by constant careful examination of the plants which come in his way, so that should there be any abnormality in the fronds over which his eye travels, he may at once detect it.

It often—nay, generally—happens that a new discovery is only betrayed by the merest tip of a frond peeping through

a mass of common ones, though, on the other hand, some of the grandest finds have been found standing out as conspicuously as possible even in much-frequented places. It is, indeed, astonishing what blindness in this respect exists among the rural classes, and especially in the ferniest districts; many of the country folk, it will be found on inquiry, are hardly aware there is more than one species, and the hunter is frequently directed to a fine hunting-ground, only to find a heath covered with Bracken. Be it, however, remarked, *à propos* of the Bracken (*Pteris aquilina*) that this is by no means to be despised by a beginner, since nearly every common where it grows freely will yield marked variations of form, frequently very distinct indeed. There is, however, one drawback to the pleasure of hunting the Bracken, since, should the ardent student find something really good, he will probably have to content himself with a frond only, as it rarely survives removal, except in winter, when dormant, and, indeed, it usually defies all effort to get a root, the root proper burrowing several feet deep in the ground.

This difficulty of acquisition is also experienced in other ways, and the hunter's powers of contrivance are sometimes put to very severe tests. A good thing, for instance, may be detected on the top of a high wall, or on the face of an inaccessible cliff. More tantalising yet, it may be well within reach, and yet so firmly anchored in some deep chink in a rock or wall as to need blasting-powder to get it out. It is recorded of one of the finest forms of *Polypodium* (*P. vulgare*) that the finder detected it in a very small state in a chink of a granite rock, whence it could not be removed; the rock weighed some hundredweights, but fortunately was loose. The finder rolled the rock some miles across country, got it home, and eventually induced the plant, which has a creeping root, to grow out of the chink, and permit itself to be multiplied. That form is now in every good collection.

The possibility of lighting upon varieties seems to be general wherever the normal forms grow plentifully; but there are localities which seem subject to some subtle influence,

under which the chances of a find are greatly increased. North Devon appears to be thus specially favoured. We are, however, rather of opinion that much of this subtle influence, may be traced to the residence near the places affected of enthusiastic and careful Fern-hunters, who, by subjecting the district to more thorough scrutiny, increase thereby greatly the list of local discoveries, while other districts less famed in this respect are reputed comparatively barren. On the other hand, there is no doubt that one may hunt a district for miles as carefully as possible without finding any sport whatever, and then suddenly hit upon a spot where eccentricity is the rule rather than the exception.

One of the first experiences of the beginner is the discovery of what are termed "rogues," that is, Ferns which are inconstantly and irregularly eccentric, and throw up a few forked and even crested fronds amongst a predominance of normal ones. Nearly everywhere where the common Male Fern (*Lastrea Filix-mas*) grows in profusion a number of these "rogues" will be found, raising hopes only to disappoint them. To such an extent, indeed, does this occur in some localities, and so well do these "rogues" ape the appearance of constant varieties, that even the best men are sometimes deceived. This inconstancy sometimes assumes other forms; and, in fact, the Fern-hunter must always be prepared to carry home a good percentage of worthless plants, since it is not always possible to discriminate with sufficient certainty to reject with safety.

The common Bracken, too, has a way of imitating nearly all the other species, popping forked tips through the hedges, and beguiling the passer-by with false expectations.

All these disappointments and difficulties, however, add zest to a day's walk, and are far more than repaid by the thrill of pleasure which accompanies the discovery of an undoubtedly good thing, and the first contemplation of a form of Nature's handiwork which now for the first time gladdens the eye of man. This point once attained, the beginner becomes the enthusiast, and will henceforth pursue his researches with a different spirit and with greater gusto,

since it is difficult, until one such experience has been made, to believe that such a reward can really be reaped. It need not be imagined that very unfrequented places must be visited, though of course there is the better chance. Most of our own finds, however, have been espied by the high-road side, either in the hedges or in the stone dykes. Seedlings, especially in such localities, may yield a prize, since it must not be forgotten that Nature is always at work, and that this year's crop is as likely to afford varieties as that of any previous year. Hence, where there are plenty of plants, there is always a chance for the eye that is keen enough, and the experience which is ripe enough to enable it to appreciate what it sees.

As a rule, the abnormal forms are found singly, the most careful search for similar forms in the same locality leading but to negative results. This is rendered the more remarkable by the fact that the specimens are, as often as not, well-established fertile plants, which have probably scattered their millions upon millions of spores about the neighbourhood for years, which spores, under cultivation, yield plants all true to the parent type. In the case of very heavily-crested forms, this may be accounted for by the greater size and vigour of the normal forms, which cause the young seedlings, should they appear, to be overgrown and crowded out of existence; hence, the interstices of stone dykes and walls, and similar places, are more likely to reward the searcher than places where the plants can grow with greater freedom. On the other hand, it occasionally happens that an abnormal form will be found to have established itself in great numbers, even to the exclusion of the normal. Instances are also on record where a whole laneful of crested forms has been found. There is an entire hillside in Westmoreland covered by a most extraordinary form of Bracken, apparently so heavily crested that the plants look like bunches of grapes hanging down the slope. Abnormal forms of Hartstongue have also been found occupying a large area, to which, however, they were confined. Considering the absolutely microscopic size of the spores of Ferns, the incredible numbers

which are thrown off year after year, and the facility with which they can be transported by the wind, and by other means, this isolation or confinement to special localities is very remarkable. It can hardly be imputed to subtle local influences in the soil, as, under cultivation, the spores generally germinate with the usual treatment, and the plants retain their peculiarities when transplanted.

The entire absence of some species in many localities and spots which seem exactly fitted for them, is another peculiar feature. The common Hartstongue, for instance, is a comparatively rare plant in Scotland, although one would expect to find it in profusion in the innumerable glens which abound there, and which seem the very *beau idéal* of a habitat for it. Yet this Fern is one of the least dainty in its requirements, seeming to have no antipathy in the matter of soil or position, and in many localities thriving in abundance under the most diverse conditions, either in a small state, on dry, exposed walls, or throwing up huge fronds in the shady woods, where it can revel in abundance of leaf-mould and moisture. We are inclined to think that the greater or less predominance of certain forms of minute insect life may account for these peculiarities of habitat. Just as we find in our gardens that certain vermin attack and destroy certain plants, so it is only reasonable to assume that either the spores or the prothalli of these Ferns are the favourite food of some of the minuter insects, in order to explain the absence of adult plants. Climatal conditions are, of course, a potent factor, but do not account for all the phenomena observed. Some exotic Ferns it is quite impossible to grow unless isolated, slugs or snails being attracted from a considerable distance, presumably by some odour; *Camptosorus rhizophyllus** (an exotic Hartstongue) suffers thus. Other plants are specially subject to the attacks of woodlice; and as, doubtless, such special appetites characterise also the minuter and microscopic insect world, and as it is manifest, when we consider the myriads of spores which are shed in

* Syn. *Scolopendrium rhizophyllum.*

vain, that these must become mainly the food of such tiny creatures, we need hardly seek further for a solution of the mystery. A harder or softer envelope to the spore, or a more or less attractive flavour in the plant itself, would determine for or against its survival in the struggle for existence.

It will be seen from the foregoing remarks that the Fern-hunter has a wide field opened to him for general observation in connection with his search for Ferns, and he will find it immensely to his advantage to take special note of the conditions under which his finds are discovered. By so doing he arrives at a practical knowledge of their requirements, which will aid him materially in his attempts at cultivation. He will soon find out, for instance, that a sudden change in the geological conditions may present an altogether different set of Ferns for his inspection, a few yards making all the difference between profusion and utter absence of certain species. He will also find that some species are never found on limestone; others only on that formation. Clay lands are usually poor in results. Some Ferns only affect boggy spots; some demand perfect drainage, and never grow upon the soil itself; others are never found below a certain level on the mountains; others, such as the Bracken, cease to be seen at a certain height; and so on. Indeed, as in all other natural pursuits, it will be found that every fact is but a link in a chain, and that Fern-hunting may be made the nucleus of endless study and endless enjoyment of the results achieved.

One advantage possessed by Ferns is their strong vitality, which enables them to survive knocking about for several weeks, if their roots be only wrapped up in moss when found, and not permitted to get dry. If they, then, be packed close together in an open box, and kept in the shade, a collection may be added to for a week or two, in full security that at the conclusion of the holiday the hunter may reckon upon their survival when duly planted and installed in their new home. As we have indicated above, he must then be prepared for some disappointment when they develop, as a good percentage are tolerably sure to turn out normal, the presumed

sport being due to accidental injuries or temporary eccentricity. Here and there, however, if he be ordinarily fortunate, he will enjoy the pleasure of seeing the new fronds slowly rise and develop the hoped-for beauties, a pleasure which will reward him amply for all the labour their discovery has involved, and which, if he be a beginner, will infallibly result in making him thenceforth a confirmed and enthusiastic Fern-hunter.

CHAPTER II.

ON VARIATION GENERALLY.

WE are constantly brought into contact with the phenomenon of variation, since it is precisely due to its existence that we are enabled to discriminate John Smith from Tom Robinson, and to single out, without the shadow of a misgiving, all our numberless friends and acquaintances, male or female, from the myriad similar human beings with whom we find them associated.

The saying that "variety is charming" is universally accepted as a true one, but few consider what the world would be without it. Imagine, for one moment, for instance, what a lively state of affairs it would cause in society if every man or woman exactly resembled every other. In Shakespeare's "Comedy of Errors" we see how complex matters became owing to only two couples—these both males—lacking this essential element of variety, the imbroglio of mistakes between masters and men, and, worse still, between husbands and wives, being endless. If, then, this uniformity were to be carried a step further, and become general, we can easily see that the whole foundation of civilisation would be undermined, and chaos would come again; the great question of "Who's who?" upon the more or less easy solubility of which modern life is built, being thereby

rendered a dark and impenetrable mystery, until some beneficent fairy should step in and restore the long noses, short noses, snub, Semitic and Roman noses, thick lips, thin lips, big mouths like caves, and little ones like rosebuds, &c., which now render recognition easy, enabling us skilfully to evade a bore on the one hand and to buttonhole our unsuspecting friends on the other, or to meet our new loves and avoid our old ones, with a fair certainty of not reversing the process by mistake.

Amongst our fellow-countrymen our powers of recognition in this respect are sharp enough; but if we went, say to China, we should find that the general characteristics of high cheek-bones, slanting eyes, sallow complexions, short noses, and pig-tails, would necessitate a certain apprenticeship before we could easily detect the celestial John Smith from the celestial Tom Robinson, though the difference between the two, to celestial eyes, is probably striking enough.

To descend a bit in the scale of creation. To the ordinary observer it would be impossible to detect, much less define, the difference between one sheep and another in a flock of the same breed, yet the breeder will have no difficulty in finding better or worse points among them; while it is notorious that many shepherds can recognise, unfailingly, every sheep in their care. These external differences between the individuals are further supplemented by, and are partly the result of, differences in temper and constitution, which represent what may be termed moral variation, as distinct from physical. These differences, subtle or manifest, characterise every individual thing in creation; so that it may safely be affirmed that there are no two living beings, from the monad to the man, which, however alike apparently, would not, if brought together and compared, be found to differ, not only in one, but in many respects—*i.e.*, would betray variation.

The tendency of Nature is, by the free intercourse among the various individuals of a species, to check the growth of any type of variation in special directions, and so to maintain a fair level of uniformity; if, however, a change of the conditions of existence be brought about, then any variations

which help existence under the altered conditions will manifestly be fostered, and tend to accumulate, because the individuals so favoured have a better chance of longer life and more numerous offspring. For instance—in order to keep to our subject—if a number of Ferns be transported to a warmer or colder climate than is natural to them, in the first place, only those survive which are best fitted to stand the change, and in the succeeding generations, all those of their offspring whose constitutions vary ever so little in the right direction will grow stronger, scatter more spores, and transmit their greater strength continually, until, in course of time, the balance will be restored, and a tribe of Ferns of a different constitution, and, what is more to the point, of distinctly different appearance, will be found to exist.

This is Nature's general method, which is a slow and mercilessly extravagant one. But if we bring man upon the scene, with his selective and protective power, the process is enormously accelerated; and, practically, he can do as much in the way of re-modelling a cow, a dog, a pigeon, a flower, or even a Fern, in his own lifetime, as Nature, left alone, would accomplish in thousands of years. This re-modelling is effected by the constant selection by the breeder, or horticulturist, or Fern-lover, of the types nearest to his ideal one, and the rejection of all others, the result, in most cases, being eventually the production of a breed or strain possessing exactly the points aimed at.

This is usually the accumulated result of many small differences, but not always. Nature every now and again takes, as it were, a jump, the offspring of both animals and plants being sometimes extremely different from the parents, new breeds and strains thus originating which would otherwise never have been dreamt of, and which, it may be remarked, are not always capable of long survival in the struggle for existence, their eccentricity being against them, and not in their favour; or, as we have said, it may be obliterated by crossing with the common form. Ferns, especially, seem gifted with this power of producing dissimilar offspring, since many of the more marked and extraordinary forms have been found

wild, and quite solitary in their peculiarities, no intermediate form between them and the common having rewarded the most careful search, either at the time or subsequently.

We are thus driven to the conclusion that such forms are the direct offspring of one of the common Ferns in whose company they were growing when found. The two most striking varieties of Lady Fern (*Athyrium Filix-fœmina**), *Victoriæ* and *acrocladon*, are examples of this; and so, of course, are all the entirely barren forms, such as the many wild finds of the frilled Hartstongue (*Scolopendrium vulgare*, var. *crispum*), the Welsh Polypody (*Polypodium vulgare*, var. *cambricum*), and others, which, presumably, must have originated from fertile—*i.e.*, spore-bearing forms—the only alternative being bud-sports—*i.e.*, plants varying from the parents originating from a bud on roots or frond instead of from a spore, a thing which occasionally happens in Ferns as in other plants, but which does not alter the case one jot.

The subtle and wonderful change which must take place in the mother-cell, whether of spore or of bud, is just as striking and incomprehensible, especially when we consider, not only that the resulting plant may assume a totally different plan of growth, but is henceforth endowed with the power of exact reproduction of itself, with all its peculiarities, through its spores—if it be fertile—just as constantly as its ancestors, for ages untold, had reproduced themselves. This constancy may be regarded as the rule with all very marked and symmetrical forms, but there are some most striking exceptions, in which, though the plants retain the abnormal form, their progeny revert more or less to the common. We have ourselves raised a very robust and heavily-crested form of Hard Fern (*Blechnum Spicant*†) from a wild find of similar character but smaller growth. Strange to say, the sowing from which this splendid plant originated was so nearly a failure that only the one plant resulted, which, as stated, surpasses the parent; yet when spores of this more marked variety were sown, fully 90 per cent. were

* Syn. *Asplenium Filix-fœmina.* † Syn. *Lomaria Spicant.*

absolutely common Hard Ferns; two only closely resembled the parent; one far surpassed it; several are of a different type of cresting; one is extremely dwarf, with fronds absolutely fan-shaped—and between these and the common ones there is every grade of cresting, from merely squarish tips to ball-like tufts. It is manifest that, in the production of new and distinct varieties, such inconstancy as this plays an important part, though it proves a sufficiently awkward factor where the propagation of the parent form is aimed at in any quantity, the only certain way being division of the plant itself.

It may be taken as a rule that when once the common form has varied, the tendency to vary again is increased; hence, it has been possible—as in the case just cited—starting from a wild find of distinct character, to obtain, in a few generations, by careful selection, plants of continually increasing beauty.

By reference to Plate I., a very striking instance of this will be seen. Fig. 1 represents the pinna of the common Lady Fern; Fig. 2, pinna of a plumose form of same, found at Axminster, and undoubtedly the offspring of the common form. A spore from this find gave the much more delicate and finely-cut form seen in Fig. 3 (*A. F.-f. plumosum elegans*, Parsons); and, finally, a spore of this made the immense stride manifest in Fig. 4 (*A. F.-f. plumosum cristatum superbum*), in which not only are all the ultimate divisions much lengthened and curved, but a crest has developed at the tips of frond and pinnæ. This, in its way, is decidedly the most beautiful plumose form yet raised. The spores of Fig. 3—its parent—are singular examples of irregularity in the transmission of the parental character. In two well-authenticated cases all the offspring, with only two or three exceptions, were heavily crested, though the parent has not a trace of this character; the exceptions were true to the parental form. The rest, with the exception of Fig. 4, though symmetrical at first, became irregular and ragged in outline as they grew large and hence were worthless. What Fig. 4 will produce is a question for the future.

Another and very provoking form of inconstancy to which—especially amongst the soft prickly Shield Fern (*Polystichum angulare*) varieties—some of the best forms are liable, is a tendency to revert to the common form directly anything in the soil or treatment disagrees with them. They are then said to "sulk"; and some most promising finds, having taken it into their heads—or, rather, crowns—to "sulk" in this fashion, have resisted all attempts to coax them into form again, and practically reverted altogether.

We will now proceed to describe the more marked types of variation to which Ferns are subject, some of which seem quite peculiar to the family, and to have no parallels in other plants.

Cristation.—This consists in a multiplication of some or all of the extremities of the fronds and their subdivisions, forming a more or less heavy tassel. This ranges from a simple forking of the tip of the frond only, to an infinite division of all the parts, from the main stem upwards, and has been carried to such an extent in several species that, instead of a flat, feather-like frond, we have apparently a ball of very fine moss, all but resting on the soil. This cresting, which more commonly takes the tassel form aforesaid, is in its turn varied infinitely in its character, not merely by the multiplication of the divisions which form it, but also by the mode of such division. Thus, it may divide symmetrically in the same plane, forming a wide or a narrow, fan-shaped crest; or these divisions may be again subdivided symmetrically, at greater or less distances, forming a flat lattice-work. Let, then, each division be more or less twisted, and every degree of curvature will give a different effect; or the simple fan may be elongated, and the tips fanned out again. Here we have, manifestly, already a great scope; yet this is doubled by the capacity of the divisions to radiate, like the blossom of a geranium (corymbiferous), with all the like variation repeated. The crests may also be formed by undivided expansion of the tips—like a duck's foot, instead of a crow's, to give a familiar example. Then, again, all these combinations are connected with the other varying characteristics of

the frond itself, which may have overlapping or distant subdivisions (pinnæ, pinnules, or pinnulets, according as they form first, second, or third divisions), all of which affect the result so much that the eye can easily distinguish the differences which characterise many variations of the same normal form. This cresting, in one or other of its forms, is the characteristic of the major number of known varieties.

Plumation.—This is by some considered—and with reason—the most beautiful type of variation. It consists either in a much more delicate division and growth of the ultimate sections of the frond or in a greater foliaceous development, the result being as great a difference between the common and the plumose forms as that between a goose-feather and an ostrich-feather amongst the divided Ferns, such as the Lady Fern, the Male Fern, &c., and between a plain strap and an elaborate, fringed frill in the case of the Hartstongue type. In this class of variation the normal outline of the frond is maintained, or merely widened, except, of course, where it is combined with cristation, which is frequently the case.

The plumose character is usually accompanied by partial or entire absence of spores, the reproductive vigour of the plant suffering, apparently, at the expense of its leafy development, precisely as in the case of double flowers, to which it probably furnishes a parallel. There seems, however, good ground for the belief that, though spores are not formed, or very sparingly, the reproductive powers of the plant are enhanced in other ways, such as by the production of buds, latent or evident, on various parts of the fronds. From experiments, we find that the barren Hartstongue—*i.e.*, the *crispum* or frilled section—can be propagated much more freely from sections of the bases of the frond stalks than is the case with the fertile varieties. This would harmonise with Darwin's hypothesis of pangenesis, and suggests the advisability of a closer investigation of the so-called barren forms generally.

Dwarfing and *Congestion* are self-descriptive terms. Some of the dwarfed forms are extremely pretty, and specially adapted

for small collections where space is very limited. Most of the species have afforded examples of this, coupled with other types of variation.

Congestion characterises many forms, and consists in a more or less crowded and overlapping state of all the divisions, and since it usually, though not always, involves shortening of the stalks as well, generally accompanies dwarfing, and hence is classed with it.

Depauperation is a common form of variation, and is rarely regular enough in its effect to be beautiful. It is curious in its way, thoroughly healthy and vigorous plants constantly producing fronds on which the tips or some of the pinnæ are either altogether missing, irregular in length, or very ragged and imperfect, exactly as if devoured by insects. These oddities are, nevertheless, truly transmitted, in most cases, by the spores.

Variegation.—This is very rare, and we believe there have been found no regular variegated forms, such as some of the exotic species have produced, *e.g.*, *Pteris cretica albo-lineata* and others. Some forms of the divided Ferns have been found irregularly splashed with white; and yellow Hartstongues are not rare in collections.

The above form the main types of variation, and two or more of them may be, and frequently are, conjoined in one and the same plant, which, of course, immensely increases the scope. Besides these, there are endless forms which can only be classed as oddities, such as the *cornute* and *truncate* forms, where the frond is cut short, as it were, the midrib projecting suddenly from the face or back of the frond, like a thorn; or the frond ends abruptly in a pocket, or horn, or frill, or all these combined; *serpentine* forms, where all the parts, and the whole Fern itself, are lengthened, and twisted about like a serpent—striving, as it were, to become a climbing plant, like some of its foreign relations; *marginate* forms, where lines or ridges run along the upper or lower surface, parallel with the edges or midrib; *revolute* forms, where the frond is rolled up longitudinally, like a tube, the divisions taking a half-circle curve backwards; *caudate*

forms, where the divisions end in a tail; and so on *ad infinitum*.

Proliferation characterises many varieties; in this little plants appear on the stalks, edges, faces, or even the backs of the fronds. Many of the soft prickly Shield Ferns (*Polystichum angulare*) are thus affected, and look remarkably pretty when the young plants develop, as they do in profusion all along the centre of the frond, and sometimes of the pinnæ.

The same form of variation, carried to excess, often so far obliterates the differences between the species that it requires an experienced eye to recognise them. Nothing, for instance, can be more dissimilar than the Lady Fern and the Hartstongue; yet there are forms of both—dwarf and extremely crested—that are as like as two peas. The robust or giant forms of some of the smaller-growing species, and the dwarf forms of the larger, also contribute frequently to a likeness in the varieties which does not exist at all in the normal types. Fronds, for instance, of the common Polypody, fully 2ft. high, and beautifully cut, lose all likeness to the common, and resemble the Shield Fern varieties; while the dwarf form of Male Fern (*Lastrea pseudo-mas ramosissimum*), about 3in. high, would be relegated by most people to any species but the right one.

The affinity, too, between the plain strap-shaped Ferns and the much-divided ones is also curiously shown in several varieties of the Hartstongue (*projectum* series), in which there is a manifest and regular tendency all along the frond to form pointed side divisions. The converse case is seen in some of the strap-shaped varieties of the Hard Fern, in which the double comb is almost obliterated.

The great number of extraordinary forms of Ferns which have been found wild, owing to the careful examination to which the plants generally have been subjected by experienced Fern-hunters, leads, we think legitimately, to the assumption that the liability of plants to vary under cultivation is not so much greater than it is generally assumed to be under natural conditions. The great bulk of the wild finds,

by their solitariness and decided distinctness, force us, as we have said, to the conclusion that they must be sudden sports from the spores of the common Ferns with which they are found associated, there being no intermediate forms found which could support the idea of a graduated series of variations leading up to them. The difference between them and the common forms is fully as great as any recorded sudden sports of highly-cultivated plants, and often fully equals the accumulated differences of many generations of selective culture. Cultivated plants, too, it must be borne in mind, can hardly vary to any great extent without the striking difference being remarked, seeing that, in trade hands—to which our remarks especially apply—they are usually grown in orderly ranks, are constantly under easy inspection by trained eyes, and are, moreover, almost certain to pass individually through several professional hands, in their career from the seed or cutting bed to their final destination when sold, whether that be the kitchen, the conservatory, or the plantation.

Wild plants, on the other hand, are altogether differently situated; they are scattered broadcast in the most unfrequented places, are often difficult of access, and are mixed up anyhow with all sorts of other species of plants, as well as with various species of their own family, which distract the attention, that must be concentrated to reap success. A moment's consideration will show that, in the first case, the chances are all against a marked variation escaping notice; while in the second, even the most extraordinary sport is more than likely to escape attention. Yet the record of Fern finds shows us that, given a Ferny locality, and a good Fern-hunter domiciled close by, a large number of very distinct forms is sure to be added to the flora of the locality—*i.e.*, the wild plants, when subjected to the same careful examination as the cultivated ones, yield, according to our contention, equally striking results. In making this assertion, we are fully aware that we are running in the teeth of horticultural belief; but we are confident that our argument is supported by a sufficient number of facts to merit careful consideration.

CHAPTER III.

FERN CULTURE AND PROPAGATION.

Culture.

THE next step, after the acquisition of Ferns by hunting for them, or by the simpler method of purchase, is to insure their continued existence and proper development by suitable culture; and here Nature herself is the best teacher.

In the large majority of cases, as already stated, Ferns will be found growing in woods and sheltered spots where there is abundance of leaf-mould, or else upon soil of a light loamy or peaty nature; others are found inserting their tiny rootlets in the chinks, cracks, and crevices of stone or brick walls, or rocks. In all these cases there exist the first desiderata of healthy growth—viz., thorough drainage, every facility for the tender root-tips to make their way freely, and, finally, protection of the crown from hot sunshine. If, then, we desire to pot any of these Ferns, we must put, first, good drainage in the shape of broken pieces of pots, then a wisp of moss, and over that a light compost, according to Nature's own recipe. For general purposes, this compost may consist of peat-mould or leaf-mould, two parts; good loam or garden mould, two parts; and silver sand or well-washed gravel sand, one part,

mixed, and left a little lumpy. In potting, observe again Nature's procedure by spreading out the rootlets carefully, and not pressing down the soil harder than is necessary to keep the crown upright; and finally, when the plant is duly installed, water well, and leave it alone, bearing in mind that any meddling with the soil when wet, however light it may be, is apt to cause it to cake together, and thus check root-growth, and imperil the well-being of the Fern.

So much by way of general pot treatment, which will apply to all the Buckler Ferns (*Lastrea*), with the exception of the Marsh Buckler Fern (*L. Thelypteris*), which revels in mud; Lady Fern (*Athyrium Filix-fœmina*), the Shield Ferns (*Polystichum*), and Hartstongue (*Scolopendrium vulgare*); also the Oak and Beech Ferns (*Polypodium Dryopteris* and *P. Phegopteris*). *Polypodium vulgare*, as is evidenced by its thriving in the hollows of trees and similar places, where only leaf-mould or decayed wood collects, prefers an open mass of leaf-mould, with a little sand. The Hard Fern (*Blechnum Spicant*) thrives best in leaf-mould with an admixture—say one-eighth—of small lumps of clayey loam scattered through it. This Fern has such an antipathy to lime that every care must be taken to avoid its presence, either in the compost or the water used. The Scaly Spleenwort (*Ceterach officinarum**) only grows on very old walls; hence an admixture of old lime rubbish is requisite. The same remark applies, more or less, to all the Spleenworts (*Asplenium*). The Parsley Fern (*Allosorus crispus*†) will only thrive when it has to make its way through loose stones. It will always be found in greatest abundance pushing through the *débris* of weathered rocks.

With the exception of the Sea Spleenwort (*Asplenium marinum*) and the Maidenhair (*Adiantum Capillus-Veneris*), which require protection from severe frosts, the British Ferns imperatively demand perfectly cool treatment in winter, otherwise they fail to become quite dormant, and in the ensuing season grow weakly, and become the prey of vermin of every description.

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* SYN. *Asplenium Ceterach.* † SYN. *Cryptogramme crispa.*

The deciduous Ferns, such as the Lady Fern, Male Fern, Mountain Buckler Fern, Oak and Beech Ferns, and others, indicate clearly enough when their period of rest begins, the fronds withering rapidly down to the ground, and the Fern disappearing altogether from view—a fertile source of discomfort to the inexperienced, who imagine them dead, and neglect them accordingly, the result being confirmation of their fears. If, however, the pots or other receptacles be put away in a cool, damp place, or buried in the ground in a sheltered corner, so that the roots never get dried, the following spring will witness a resurrection, at the first signs of which they can be reinstated in fitting places of honour. The rapidity with which these deciduous Ferns develop their fronds is very remarkable, and as, unlike the evergreen varieties, there are no old fronds to detract from their beauty, their fresh and delicate appearance in the spring makes ample amends for their invisibility during the winter.

The evergreen species, Hard Male Fern (*Lastrea pseudomas*), the *Polystichums*, the *Asplenia*, *Blechnum Spicant*, *Scolopendrium vulgare*, *Ceterach*, *Polypodium vulgare*, retain their verdure fairly well during the winter months if kept from wind and weather. When, however, the new growth begins, the sap and vigour of the old fronds appear to be re-absorbed by the plant; it is therefore not advisable to cut away the old foliage until it has manifestly done its work, being brown and shrivelled.

Repotting and replanting may be done at any time with proper care, though they are best let alone in the winter. Obviously, the best time is just when the new growth commences, after the winter's rest, say end of March, as then not only is the plant in its most vigorous state, and ready to take every advantage of fresh soil and greater space, but if the old fronds are damaged in the process little harm is done; while if the operation be left later, the symmetry of the plant may suffer throughout the season through damage to the new growths.

Ferns in pots, like Ferns out-of-doors, must be protected from hot sunshine; wind is also very destructive where the

more delicate forms are concerned; and though the plants may exist under very adverse circumstances, the cultivator can never hope to grow Ferns to the best advantage unless he studies, lover-like, their predilections and requirements. Nature is here again the best teacher. Where do we find the Lady Fern growing shoulder high, the Hard Fern waist high, and so on? Is it not deep down in some sheltered, shady ravine, where every breeze that blows has to filter through a thousand trees, which at the same time shut out the noon-day sun? Here is the paradise of Ferns, and the more that *beau idéal* is approached, the greater will be the success attained and the pleasure derived therefrom.

With regard to pot culture, one fact is frequently overlooked —viz., that Ferns, like other plants, when growing wild, are not turned and twisted about, now to the north and then to the south, but are absolute fixtures, and grow accordingly— *i.e.*, the fronds, as they rise and develop, adjust themselves as nearly as possible at the angle which enables them to catch the greatest amount of light. Place, therefore, a Fern at a window during its growing period, and every frond will slowly curve towards the window in such a way that, when perfect, it will be seen at its best from the outside. Ladies especially, however, try to counteract this tendency by turning the plant round, so that it may be seen to advantage from the room, the consequence eventually being bent and misshapen fronds and ugly plants, since a permanent twist is given by only an hour or two's exposure—and once this is done it cannot be remedied. Nature being thus interfered with, the old twisted fronds are in the way of the later ones, and so confusion becomes worse confounded; hence, one golden rule is, "Always keep the same side of the pot to the light," to insure which it is well to mark the pot itself.

With regard to watering, if the pots are thoroughly drained, and not too large for the plants, over-watering need not be feared, but drought alone, which to some Ferns is fatal. This, however, is only a matter of care and regularity, and the golden rule for the Fern-lover here is: "If you have anything very choice, look after it yourself."

Propagation.

Under careful culture and congenial conditions, the large majority of the best varieties will soon multiply themselves to a certain extent by the formation of adventitious crowns, produced either in a small form from buds at the base of the fronds, or by a process of fission in the crowns themselves, by which full-sized plants are obtainable. To profit by this latter process, it is necessary to permit the double crown to develop distinctly into two centres of growth; which stage attained, the plant should be taken up, and a sharp knife passed carefully between the two centres, each of which will then be found to possess its own set of roots and fronds, and to be, indeed, a perfect plant, only needing independent potting or planting to form at once a fair specimen. The intermingling of the fronds, when the crowns are permitted to multiply without separation, often detracts from the grace of the plant, and hence, for this reason alone, separation from time to time is advisable. Such Ferns as are apt to form bushes, not by this process of fission, but by side buds—the crested Male Fern, for instance—are greatly benefited by the removal of these small plants immediately they appear, the result being a much more vigorous and symmetrical growth of the parent crown, whose roots have thus freer scope, and all of whose energies are concentrated in its own development. Under this treatment, the Fern named forms, in a year or two, a decided trunk, and becomes a veritable Tree Fern, which it will not do otherwise.

The little plants produced from buds are best detached by passing a blunt ivory or bone knife between them and the parent, when they will come away with a little bunch of roots all ready for installation as future representatives of the race. These should be pricked out an inch or so apart, according to size, round the edges of small pots or pans filled with rather more sandy compost than that already indicated. If then put into some damp, shady corner, they will soon develop into pretty plants.

Some of the abnormal forms afford another method of propagation, by means of buds which appear on the surface of the fronds and elsewhere. Many of the Polystichums develop these in profusion, the old fronds throwing up a mass of tiny new growth along their midribs before decaying altogether. Such fronds only require pegging down flat as they are, to yield youngsters in abundance. Some Scolopendriums produce buds on their stalks, and on the surface and edges of the fronds, which can be treated similarly. The edge buds require to be cut with scissors, so that a little tongue of the old frond may serve to fix them in the soil, and act as a temporary substitute for roots. A few forms of the plumose sections of the Lady Fern have been found to produce bulbils on the backs of the fronds—a characteristic, so far, only remarked in connection with this family. For many years these resisted all attempts to produce plants, but recently success has established the fact that they are true buds, as open to propagation by pegging down as the others.

It has also been found that the basal portions of the old, decayed fronds, which retain vitality for many years, are capable of developing buds when detached from the old crowns and inserted in sandy compost. The Lady Fern, Male Fern, and Hartstongue, and probably other species, permit of this method of propagation, which, in the sporeless Ferns, is sometimes the only one available.

The propagation of those Ferns which, like the common Polypody, Bladder Ferns, Maidenhair, and the Filmy Ferns, have creeping rootstocks, is a very simple matter, since every piece of the creeping rootstock (*rhizome*), bearing a few root fibres and a frond, is fairly sure to yield a plant if pegged firmly down upon the surface, and the rootlets carefully covered. The edges of pots and pans seem the most congenial places for such, the evaporation through the porous material probably assisting root formation, by keeping the soil sweet, and promoting circulation.

Three abnormal forms, one Lady Fern and two Polystichums, have recently been found to afford instances of an altogether

new method of reproduction, termed apospory.* Propagation in these cases is effected, not by spores, but from peculiar growths at the back of the fronds or at the tips of their ultimate divisions, which growths, when pegged down, yield young plants by the generative process usually peculiar to spores.

Finally, there is the method of spore-propagation, which, involving as it does a description of the spore itself and its peculiarities, merits an independent chapter.

* *Vide* Appendix.

CHAPTER IV.

THE WONDERS OF THE SPORE.

AMONGST the many wonderful things which the botanical student comes across, few, probably, are more striking, when thoughtfully considered, than the microscopical spores of the *Cryptogamia*, or flowerless plants, and the reproductive phenomena which they present for his observation.

Ferns, the aristocracy of their tribe, afford the greatest contrast between the spore and its results. Take, for instance, the largest of the Tree Ferns: here we have nothing less than a noble, stately tree, possibly 100ft. in height, with a huge, spreading crown and massive trunk in proportion, the whole of which has been developed from a microscopic spore, invisible to the naked eye. If we examine the fronds of that huge tree, we shall probably find the backs entirely covered with small, brown patches, lines, or dots, of which there will be countless myriads upon a single frond; yet, notwithstanding their number, every patch, line, or dot will, under the microscope, resolve itself into not merely a heap of spores, but into a heap of hundreds of capsules, or pods, each of which in its turn, though itself barely visible, contains some forty or fifty spores. Hence, there are many thousands of spores in every patch, or myriads of millions on every frond, every individual of which is capable

of reproducing the parent form in all its luxuriant and stately magnificence.

To bring this illustration of fecundity home to the mind, we have estimated the spores upon a single frond of our native common Polypody (*Polypodium vulgare*), and found that one of the sub-divisions of the same size, taken from a Tree Fern, would yield plants sufficient to form a wood as large as Epping Forest. Every frond would bear hundreds of such sub-divisions, and the Tree Fern would probably bear thirty to forty fronds every season. A little calculation, therefore, will show that really inconceivable numbers have to be dealt with. Notwithstanding this marvellous fecundity in point of numbers, it has been demonstrated that it does not end here, each spore being capable of producing, under certain circumstances, not merely one, but several plants, so that there is, practically, no limit to the reproductive powers of the Fern family.

On the other hand, this wonderful fertility as regards numbers would appear to be very nearly counterbalanced, in a general way, by the minuteness of the spores handicapping them severely in their first stages of development. As an illustration of this, we recently gathered, in the winter, six dead, shrivelled fronds, from a plant of the Victoria Lady Fern (*Athyrium Filix-fœmina Victoriæ*), and which had, presumably, shed their spores; yet, on placing these between paper, in a warm room, in a few days a heap of remaining spores was shed, sufficient to fill a teaspoon. Our first impression naturally was that this heap consisted merely of the empty capsules, but, to our surprise, the microscope revealed spores in abundance; in such abundance, indeed, that, by careful sub-division, we were enabled to make a fair estimate, and found that there were at least *eighty millions*—a number which, enormous as it is, was, beyond a doubt, far exceeded by that of the spores which had been shed broadcast in the Fernery where the plant was growing. Yet, though the plant has occupied its position for five years, and there are a thousand chinks and crevices around it, which should give the spores a fair opportunity of development, it

is a remarkable fact that not a single chance-sown plant has made its appearance amongst the innumerable seedlings of other Ferns which spring up in profusion under identical circumstances. Again, this Fern, which, from its unique and unmistakable form, is fitted admirably for our illustration, was found wild as long ago as 1861, shortly after which, being, as we have demonstrated, a remarkably fertile plant, it was propagated from its spores, and distributed all over the country, so that, at the present date, plants as fertile as the parent exist in every collection, even the most humble. This being so, we would naturally expect that escaped spores from some of these cultivated plants would have yielded apparently wild ones; yet, in the course of twenty-seven years, not a single new find of that form has been recorded.

Our readers would naturally jump to the conclusion, from the foregoing remarks, that the Victoria Lady Fern is especially difficult to raise from its spores artificially, instead of which, if the spores be sown with ordinary care, and protected fom disturbance, they germinate freely and produce abundance of plants, all of the parental type. It is manifest from this that, in some subtle way, the spores of this Fern are more heavily handicapped, under natural conditions, in their early stages of development, than other abnormal forms of the Lady Fern, which become veritable weeds under precisely the same conditions of growth.

It will have been gathered from the foregoing remarks that there must be some essential difference between these spores and the seeds produced by flowering plants. In the first place, a seed is the resulting product of a fertilised flower, and, when sown, the immediate offspring is a plant like the parent, and capable of producing flowers in its turn. Place, for instance, a mustard seed in the ground, and very speedily it splits open, a root protrudes and penetrates the soil, and immediately thereafter two little leaves expand, and a mustard plant is before us without further change. The Fern spore, however, differs by not being the product of fertilisation; nor does it produce directly a plant anything like the parent, but another kind of plant altogether, resembling

a small, green scale. Upon this scale—on its under surface —there are then developed certain organs, akin to flowers, which, in this second generation, become fertilised, and produce a bud, or we may call it, perhaps, an attached seed,

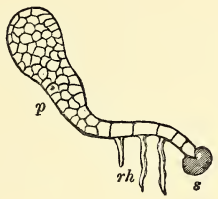

FIG. 1.—YOUNG FERN PROTHALLUS, much magnified—*p*, Prothallus ; *rh*, Root-hairs of Prothallus ; *s*, Spore.

which then proceeds to reproduce what we recognise as a Fern, and regard as the real parent.

This small, green scale, which is termed a prothallus (*p*, Fig. 1), is produced from the spore (*s*) by simple generation of cells, the first of which emerges from the spore, and multiplies itself by fission, and the attendant formation of

FIG. 2.—LOWER SURFACE OF MATURE PROTHALLUS, magnified—*a*, Archegonia ; *rh*, Root-hairs.

tiny root-hairs (*rh*), by which due nourishment is obtained. When this prothallus attains a heart shape (Fig. 2)—generally about ¼in. in diameter—there are found upon its under surface, among the root-hairs and elsewhere, many organs of two

characters from one kind of which (antheridia, Fig. 3) issue, in due course, numerous minute organisms (antherozoids, Fig. 4), somewhat resembling microscopic tadpoles, which swim

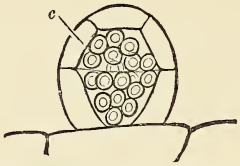

FIG. 3.—YOUNG ANTHERIDIUM (MALE ORGAN), much magnified—*c*, Central Cell, filled with Antherozoids.

FIG. 4.—ANTHEROZOID, much magnified.

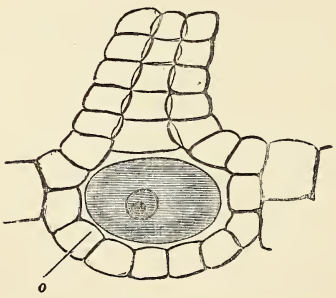

FIG. 5.—LONGITUDINAL SECTION OF MATURE ARCHEGONIUM (FEMALE ORGAN), much magnified—*o*, Ovum.

about actively in the moisture around them, and finally fertilise by contact the other kind of organs (archegonia, Fig. 5, and *a*, Fig. 2), which possess a germ-bud or ovum (*o*);

this then develops into a Fern proper, in the manner indicated on an enlarged scale by section in Fig. 6, and finally completes the reproductive cycle as in Fig. 7. As both these organs

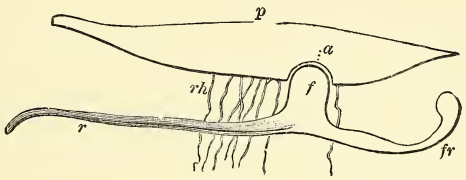

FIG. 6.—SECTION OF PROTHALLUS AND YOUNG FERN, much enlarged—*p*, Prothallus; *rh*, Root-hairs of Prothallus; *f*, Foot of Young Fern, embedded in hollow of enlarged Archegonium, *a*; *fr*, Very Young Frond; *r*, Root.

are scattered over the prothallus, it has been found that division of the prothallus by a sharp knife may lead to the production of a corresponding number of centres of growth

FIG. 7.—PROTHALLUS AND FERN AT LATER STAGE.

and resulting plants; whereas, if left undivided, it would seem that all the energy of the prothallus is absorbed by some one centre, which obtains predominance, the remainder perishing.

The prothallus has also been found capable of producing Ferns, in some instances, by simple buds emanating from its under surface, independently of the reproductive organs—this is called Apogamy; the crested Hard Male Fern reproduces itself in this fashion. The prothallus also multiplies *itself* sometimes by budding—*i.e.*, produces fresh prothalli—so that many plants may result from a single spore without cutting; the Royal Fern (*Osmunda regalis*) does this. On the other hand, the prothallus may be produced by direct outgrowth from the Fern itself, instead of from the spore (*vide* Appendix *re* Apospory), which is the latest vagary discovered. The only possibility now apparently remaining is for the prothallus to bear spores direct, and shut out the Fern proper altogether, which would represent a stride backwards to the Lichen or Marchantia families. We are, however, getting technical, so will revert to the practical again.

We gather, then, from this description of the phenomena of reproduction (1) that the spore must be located upon a congenial surface, so that when it bursts the root-hairs may find due nourishment for further growth; (2) that when the prothallus has developed, the surroundings must permit a deposit of moisture upon its under surface—this implies a thoroughly moist atmosphere.

It is also manifest, from the minuteness of all the operations, that disturbance at the early stages would probably be fatal, and that insect life, or, indeed, any life at all with which the tiny embryo would have to contend for existence, is to be avoided. With these facts in mind, let us see how to proceed.

How to Sow the Spores.

Take a shallow, porous, red earthenware pan, about 3in. deep, put 1in. of broken flower-pot in the bottom, over that a thin layer of moss or other fibrous material, then fill up the pan with ordinary Fern compost, upon the top of which scatter a few nodules of clay; press lightly, so as to make fairly flat. Now place a small piece of paper in the centre, upon which

pour gently a whole kettleful of *boiling* water, which the paper will prevent from disturbing the soil. Remove the paper, place a sheet of glass over the pan, and let it cool. We have now a congenial soil, and all spores of Fungi, or eggs of insects, are killed, thus leaving the Fern spores a clear field.

Now take a frond bearing ripe spores—*i.e.*, speaking generally, brown ones—and lay it for a day or two between two sheets of white paper in a dry place. We shall then find the paper stained with a brownish dust. This dust is made up of the spores and their cases, and it is only necessary to tap this sheet gently over the prepared pan to finish the operation. Cover immediately with the glass. Make a note of your sowing—species, variety, and date and place—put the pan in some damp, shady corner, out of the way, taking the precaution that worms do not get in from below. If possible, forget its existence for about three weeks, when, if the weather has been warm, a faint trace of green will be visible, showing the spores have begun to develop. Very soon the little scales will become perceptible, and in a few weeks more the whole pan will be covered. To this there succeeds an apparent dormancy, lasting sometimes for weeks; the reproductive phenomena already described are, however, now going on, and the next thing will be the sudden appearance, at first here and there, and eventually in a crowd, of the first little fronds proper, when the success of the sowing may be recorded.

Should, however, the prothalli cover, as is probable, the whole of the pan, it becomes manifest that there will soon be a great struggle for existence, as the little plants require elbow-room. It is, therefore, well at this stage to prepare other pans in the way indicated, and with a pointed knife, or stick, pick out small patches, about the size of peas. Insert these carefully in the soil, just so that they adhere to it, and about lin. apart, and cover again with glass; the result will be a greatly accelerated growth.

To the beginner's great surprise, it is most likely that, instead of Ferns appearing, as per his register, other species altogether may predominate, even at first, to the entire exclusion of those he looked for; these latter will, however, probably appear later.

This is owing to the fact that some varieties, whose spores naturally fly about and settle upon all the Ferns around them, germinate and develop much more rapidly than others; hence, if any of their spores have settled upon the fronds from which the sowing was made, there is no possibility of discriminating them, and all that can be done is to weed them out eventually, should they threaten to choke out the sorts especially desired.

The next, and to the *connoisseur* the most fascinating, stage of Fern-propagation by spores is the careful search through the resulting crop for new or improved forms among the rising progeny of already splendid varieties. Here and there the experienced eye will detect some unusual or especially promising feature as the young fronds develop; these may either be marked and left where they are, or, better still, carefully lifted out, and placed in a pan reserved for that purpose. By-and-bye, new fronds arise, which perhaps confirm, perhaps upset, his expectations; but to the persistent cultivator every now and again his warmest hopes are more than crowned, and he has the proud pleasure of scoring another success, and adding one more gem to his and others' collections.

The best time for sowing Fern spores is immediately they are ripe, as this generally gives ample time for the formation of the prothallus before the cold weather sets in. In this case, though they will remain at a standstill during the winter (unless kept in a warm house, which should be done whenever practicable), the young plants will appear in the spring, and have the whole of the season before them for development, thus saving a month or two.

For the beginner the Lady Fern is probably the easiest of all to raise; if the spores of fine varieties are available, it is just as well to begin with good forms as inferior ones. The Male Ferns and Scolopendriums are also likely to yield a successful crop, but the beginner must not be disheartened by a failure or two, though with careful following of the above treatment in every respect, success should be the rule, and not the exception. Should the dormant period, after the formation of the prothallus, be very protracted, a gentle watering, through a fine rose, with warm water (70deg. or 80deg. F.)

will speedily bring matters to a crisis, and lead to the young plants appearing.

Should Fungi appear, or worms get in, it is well to prick out sound patches of the prothalli at once into other pans prepared as already indicated; with care, this can be done at any stage of development.

In selecting spores for sowing, not only should the best varieties be selected, but also the best and most characteristic portions of the fronds should be sown from. Thus, if a good crested form is in question, and heavier cresting aimed at, the spores should be taken from the heaviest crest itself, if possible. Some very fine and constant forms have been raised from spores taken from plants which only showed a trace of variation in one small subdivision of a frond, the spores upon which produced plants so characterised throughout.

As it is very difficult for the beginner to realise that an insignificant-looking patch of spores, no larger than a small pin's head, will produce many more plants than he is likely to be able to accommodate, a word of warning as to sowing too thickly will not be amiss. The best plan is to put a very small pinch of spore-dust under a good microscope, which will resolve it into the equivalent of a peck or so of fair-sized seed, and thus bring home to him tangibly the extent of the crop he is likely to reap.

Hybridisation.

Although, owing to the minute nature of the phenomena, this can hardly be effected systematically, as with the flowering plants, yet the sowing of spores of several varieties together results sufficiently often in offspring of mixed characteristics to show that crossing does take place. This fact, therefore, may be borne in mind with advantage, and give additional interest to this method of propagation.

Colonel Jones, of Clifton, Mr. Clapham, Mr. Lowe, and others who have directed their attention specially to this, have succeeded over and over again in their well-defined aim at

producing crosses combining the characters of specially fine varieties. An instance of one of Mr. Clapham's successes in this direction is seen on Plate V., Fig. 12, which shows an intentional cross between a beautifully-crested Polypody (*Polypodium vulgare bifido cristatum*, Fig. 2) and a very finely-divided one (*P. elegantissimum*, Fig. 10); the result being not only the transference of the characteristic cresting of the former to the latter, but also its peculiarities to the otherwise normal fronds which the latter is in the habit of producing occasionally—a feature which, of course, places the cross beyond a doubt.

CHAPTER V.

FERN POTS, PANS, AND CONTRIVANCES, ROCKWORK, &c.

IN the cultivation of Ferns under artificial conditions, such as in glasshouses, Wardian cases, frames, &c., there is ample scope for the ingenious in contriving suitable receptacles for the plants, which, without being unsightly or expensive, shall meet the requirements of species of varying habit—drooping, upright, spreading, creeping, or otherwise. Nothing, of course, can be better for many purposes—where, for instance, the object is to mask a wall—than the many forms of flat-sided hanging pots of red ware, which can be purchased at moderate prices.

Cork baskets or half-baskets are also available, and possess the advantage of being easily made and as easily secured to the wall by means of copper wire and wall hooks, as described later on. Care must, however, be taken that these are thoroughly filled with earth when the Ferns are planted, as, otherwise, the soil may settle into cavities, in which the roots are left exposed and perish, or the plant may suddenly subside, and require lifting to be presentable. Cork, however, is not of itself very congenial to plant growth, as there is no evaporation through it, and it affords no attraction for the

roots, such as porous earthenware furnishes; it is also liable, in time, to harbour woodlice. Apart from these drawbacks, it is so easily manipulated, and, when well arranged, has so rustic an appearance, that it can hardly be dispensed with where considerable space has to be covered.

In selecting cork for basket or pocket-making purposes, the large, tubular pieces should be chosen, as these, if soaked for some time in water, can be forced open, sawn with a coarse rip saw or cut with a wet knife into lengths, and being kept open by the insertion here and there of a stick, only require a flat piece wired on as a bottom to form a neat receptacle

Fig. 8.—Removable Slate and Cork Wall-pocket.

with little trouble—the wall itself, to which it can be attached by wire, forming the back. Large baskets can be made by judiciously wiring curved pieces together; gaps can be left to accommodate small plants.

A useful removable wall-pocket of this class can be constructed by wiring a curved piece of cork on to a common roofing-slate, as indicated by Fig. 8, the bottom being formed by a projecting curved piece, forming a sort of small trough in front, which will hold some small Ferns, others of which can be planted with advantage in holes made in the larger piece for the purpose. If the bottom edge of the slate rests

upon a couple of strong hooks, driven into the wall, a thin wire, passed from side to side, and fixed to wall nails, will fasten it securely. A judiciously-planted basket of this description will accommodate a very handsome group of several varieties. Seedlings will also speedily make their appearance in the chinks, and must be looked after, so that the proper tenants are not crowded out.

For many purposes, however, ordinary roofing and ridge slates form a preferable material to cork. They are cheap and practically everlasting, and, with a little ingenuity, can be fashioned into a great variety of pockets and other receptacles of very simple, sightly, and unobtrusive forms, possess-

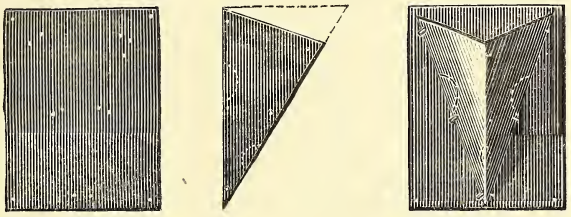

Fig. 9.—Removable Slate Wall-pocket.

ing all the advantages of cork without any of the drawbacks, and being, moreover, of that porous nature which stimulates root-growth.

A supply of roofing-slates, of the usual oblong shape and size, and ridge-slates, which are much longer, narrower, and stouter, an old saw, a bradawl or drill, an old rough file, a pair of good cutting pliers, and some stout copper wire, are all the materials and tools required.

A few examples of this class of work will suffice. In Fig. 9, A represents a roofing-slate pierced with holes, as indicated; B, another sawn across diagonally, and a piece cut off from each half, as per dotted line; two semicircular notches may be bitten out by the pliers as shown, to accommodate

small Ferns, and holes pierced as indicated. If, now, these three pieces be wired together, they form the pocket as shown at C; the corner holes can be used as screw-holes for attaching to wood, or for wiring up on bricks. To tie together with wire, cut the copper wire into short pieces, bend them like a horseshoe, pass the two ends through the proper holes *in*

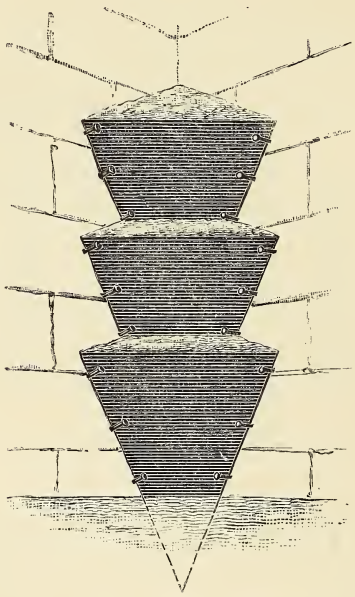

Fig. 10.—Corner Pockets.

front, and twist together tightly, but not too tightly, at the back. Slates, sawn into the shape of a triangle, will form corner wall-pockets by themselves, nails being driven into the wall to support them. As will be seen by Fig. 10, these can be inserted one inside the other, as many as taste or space permits, the plants in each not interfering in any way with one another.

These pockets can also be used singly as masks for ordinary pots, which can be inserted and the space filled up with moss, sand, or compost.

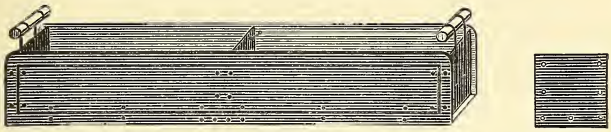

FIG. 11.—SLATE BOX FOR WINDOW-SILL.

Fig. 11 represents a long slate box suitable for a window-sill. This is formed entirely of ridge-slates, three of which

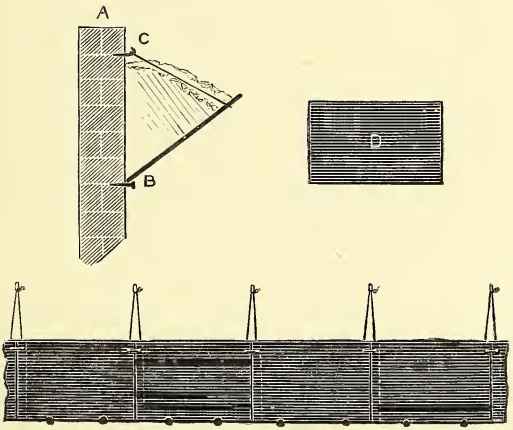

FIG. 12.—CONTINUOUS SLATE POCKET.

form the bottom and two sides, while three square pieces form the two ends and centre strengthening-piece; the handles

are formed of stout pieces of bamboo, attached by extra strong copper wire through holes in end-pieces. With a straight-edge and bradawl marginal or other lines can be scored, by way of relief, and the corners are rounded with the file.

Other forms will soon suggest themselves, and the hints above given should suffice for their execution.

These same roofing-slates—which, by the way, should be selected as stout as possible, and free from flaws—can be used to form a capital, long, continuous receptacle for the smaller-growing and wall Ferns, the top of an old wall being, indeed, the idea aimed at. This is formed against a wall, at about the level of the eye, in the manner shown in Fig. 12. A represents the wall; B, a level row of strong nails, driven about 6in. apart into the wall; C, a row of hooks—if galvanised, so much the better. The slates are then pierced with *two* holes in one of the two upper corners and *one* in the other, as shown at D. If, now, the bottom edge of the slates be rested upon the lower line of hooks, and their edges overlapped, so that the holes nearest the edge coincide, stout copper wire, passed through, and over the upper hooks and back again, will at once tie the slates together, and suspend them safely at such an angle as will form a continuous pocket, as desired. Plenty of broken brick and rough material should then be thrown in as drainage, and when filled up with good compost, a first-class and very convenient home will be made for a select company of choice, small things.

The soil can be packed with small burrs with good results, the Ferns being carefully installed in the chinks. Many of the most difficult to grow take kindly to this sort of receptacle, which has the further advantage of economising room, since there is plenty of space underneath for larger Ferns, and hardly any liability to drip. The plants, also, being on a level with the eye, are easily inspected and kept in order.

For small seedlings, like accommodation may be afforded by the ridge-slates, suspended in the same manner, only not overlapping—which, in their case, is needless. They form, of

course, a narrow, but, at the same time, a remarkably handy, place for tiny plants which it is desirable to instal out of the reach of worms. If two ridge-slates be screwed on to three triangular pieces of wood (oak is desirable), or wired on to three pieces of slate—one at each end, and one in the middle to stiffen—a removable pocket of the same type is produced, which can be hung up upon nails passing through the holes with which ridge-slates are already provided when purchased. Handy and inconspicuous shelves are also found to exist, ready made, in these ridge-slates, all they need being strong holdfasts as supports.

For those who have not the leisure or the inclination for home-made contrivances of this sort, Booty's Fern Wall-tiles will be found to answer admirably for covering wall surfaces; these are gracefully curved earthenware troughs, which can be easily fixed one above another, and to any desired length and extent. Fern-pockets can also be constructed of small, broken burrs and good cement, care being taken to leave drainage-holes. A few strong nails and holdfasts driven into the wall assist operations of this class immensely.

This brings us to rockwork proper, or, rather, as near proper as ordinary purses and available materials permit. The imitation of real rocks we will assume to be too generally impracticable to be aimed at, involving, as it must do, if done at all well, considerable outlay as well as special knowledge. With the common refuse, however, of the brick kilns—*i.e.*, brick burrs, in which the more the bricks have lost their semblance the better, we have a material which, if it does not deceive the eye with the appearance of veritable rocks, is quite as congenial to rock-loving Ferns, affording the same protection to their roots and crowns in the chinks, nooks, and crevices which, with a little care, can be contrived.

In forming an artificial rockery, beginners usually make the mistake of building up the burrs and filling in the soil as they go on, the result being, inevitably, a great settling of the whole fabric afterwards, and a series of unsuspected holes and hollows inside, which are very detrimental to the roots of the plants, and to their well-being generally. The

proper way is to form a solid mound of soil of the full size and shape desired, and then, with the aid of a trowel, to firmly bed the masses of burr into the mound in such a way that they lie firm by their own gravity. Commence doing

Fig. 13.—Rockery.

this at the bottom of the mound, working the soil well down behind each piece, and choosing the larger pieces for the foundation; these being firmly placed, and the soil brought down behind them, the inserting of the rest will be easy.

Formality, however, must be guarded against, and space left between the masses for the eventual planting, which should not be done immediately, but after the mound has been well watered and the surplus drained away. When all is ready, work some specially good compost into the pockets and chinks, and plant the Ferns, watering them well.

With a rockery built in this fashion there is no danger of finding a number of fine plants mysteriously vanished, and gaping chinks occupying their place—a not uncommon experience when the wrong method is adopted. Any good porous

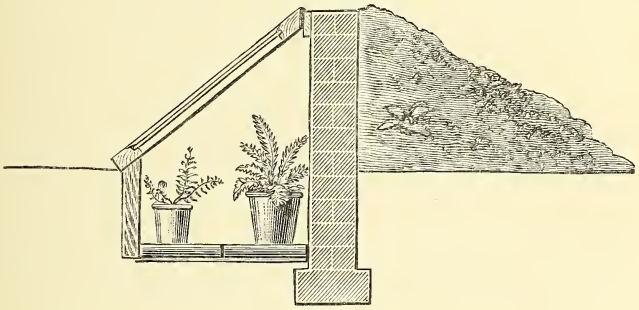

Fig. 14.—Small Fern Frame and Alpine Rockery Combined.

stone will answer the same purpose; but hewn pieces are to be avoided, for appearance' sake, and so are those abominations in connection with rockeries of this class—shells, corals, and similar ornaments, which, however beautiful in themselves, are utterly out of place, since the only ornaments should be the Ferns, which, under proper treatment, should alone be visible.

To grow Ferns in gardens where there is little or no shade would appear a hopeless task; but here their culture can be combined with that of sun-loving Alpine plants in a very satisfactory way. Let a trench, running from south-east to

north-west, if possible, be dug, about 1ft. deep and 3ft. wide, the soil being thrown up on the south side, faced with burrs, and backed with a 4½in. red-brick wall, rising about 2ft. above level of soil. The bottom of the trench is covered with thick, porous, red tiles, or a bed of cinders or cement; and the shorter wall can be formed of similar tiles, or slates, a depth of 9in. to 12in. sufficing. A series of lights, hinged on to the brick wall, and resting on the edges of the tiles, or slates, will form a long, cool, moist frame, in which a large number of good forms will thrive, the drainage from the Alpine rockery keeping it always humid, while the direct rays of the sun are warded off entirely. Such a sunken frame can, of course, be made under any shelter, but we have taken an utterly shelterless site to illustrate that "where there is a will there is a way."

Now a word as to common flower-pots. What are the emotions of an English maker when a Scotch flower-pot meets his eye? We are not in the trade, and therefore cannot be certain; but surely shame must predominate. The type of the ordinary English flower-pot is well known—a rough, clumsy, often misshapen, hand-moulded affair, difficult to clean, unsightly to regard, and only fitly used when broken up for crocks. The Scotch pot, on the other hand, is a smooth, well-turned, and altogether satisfactory piece of work, which costs little, if any more, than the others. These, owing to the absence of all roughness, either inside or out, are not only much more pleasing to the eye, but facilitate cleanliness, and in the process of repotting, or turning out for inspection, the ball of earth and roots slips out undisturbed, and can be replaced without damage to the growing root-tips, owing to absence of friction. In short, they combine the sightliness and cleanliness of glazed ware with all the sanitary benefits of the porous clay of which they are formed.

The principle involved in the porous earthenware bottles, surrounded by Maidenhair Ferns, with which our readers will be familiar, can be made available by inserting an empty, corked flower-pot in the centre of suspended baskets; the pot being occasionally filled up with water, fosters a vigorous

growth, and materially reduces the risk of drought, to which suspended plants, no matter where situated, are much exposed in hot, dry weather.

For spore-raising, seedlings, and some of the shallow-rooting Ferns, such as the Polypodies, red pans about 10in. square by 2½in. deep are very useful.

CHAPTER VI.

FERNERIES, WARDIAN CASES, &c.

ACCOMMODATION for Ferns in the way of specially-built Fern-houses, &c., is, of course, a question of expense. Fortunately, however, for the subjects of our consideration, their culture is adapted to the shallowest pockets as well as to well-filled purses. In the first place, since, with two exceptions, they withstand any amount of frost with impunity, two great items of expense—viz., heating apparatus and fuel—are quite unnecessary. In the second place, in many parts of the country—*i.e.*, in all parts where wild Ferns flourish, it is manifest that many varieties would do the like without any protection more than is afforded by congenial, shady nooks out of doors, under the shelter of trees, north walls, and so on; so that a fair collection can be made and kept in good condition without any expense beyond first cost of plants. A number, however, of the most delicate—*i.e.*, fragile—forms, though they will exist, and even thrive, under the same conditions as their tougher brethren, cannot develop their full beauty except they are thoroughly protected from the wind and rain.

Wind, in all cases—by rubbing the delicate fronds together—is a fruitful source of damage, and really beautiful plants are never seen in exposed situations. Rain, on the other hand,

with the densely-crested forms is very apt to collect to such an extent in the crest as to break down the plants; while, of course, a heavy hailstorm plays havoc with all. Hence, as a collection grows, and the more delicate and choice forms are acquired, the collector finds himself or herself compelled, sooner or later, either to take the choicest into the dwelling-house, or prepare frames or houses for their accommodation elsewhere. In the dwelling-house, provided there be no gas used in the rooms, windows with a northern or eastern aspect can be utilised to double advantage—*i.e.*, the plants benefit by the shelter and position, and the rooms are benefited by the beauty of the Ferns.

We ourselves have never had a more satisfactory collection, in its way, than an early one which occupied a square table in a bay-window facing the north. We made a sloping stage of six shelves, upon which we ranged the plants according to their size and habits, with the most delightful results, the window — or, rather, its tenants — being the constant admiration of all who saw it. The collection, however, outgrew the space, and a frame, consisting of an oblong box, about 6ft. by 3ft., 18in. high in front, 24in. behind, and covered with a glazed light, next made its appearance for the accommodation, at first of seedlings, and eventually of as many adult plants as it would hold. Frame No. 1 overflowed, and others followed. Then arose the question of a Fernery proper, which eventually took the form of a cool conservatory, facing north, with a large, burr-covered mound in the centre, a red-tiled path round that, and sloping rockwork all round the walls, which are of brick, about 7ft. high, sustaining a corrugated glass roof, sloping from the centre. The Fernery abuts upon the dwelling-house, and the dining-room window looks into it. The farther wall is built entirely of rough burrs, covered, more or less, with pockets containing Ferns. The side walls are masked by hanging-pots and slate troughs, as described in the previous chapter. This Fernery is quite unwarmed, for though heating apparatus was put in and used, we found the artificial heat in winter prevented the plants from resting, the result being weakly constitu-

tions in the ensuing growing season, and a plentiful crop of thrips and other abominations in the vermin way.

A house such as this accommodates some 400 varieties, and is a delightful sight for the greater part of the year, while, even in the winter, the evergreen varieties make a refreshing show of verdure. At first we planted all the Ferns direct into the soil of the rockeries, but found it advisable, in many cases, to plant them in pots and sink them, thus permitting re-arrangement when needed, either for the benefit of the plants or the sake of variety.

In contriving a Fernery of this or similar description, it must be borne in mind that coolness and shade are essential conditions of the well-being of the plants. These conditions can only be fully attained in a sunk house, built on the principle of the frame described in Chapter V., and well protected from the direct rays of the summer sun.

For the accommodation of the class of Filmy Ferns, of which the British representatives are the two forms of the Tunbridge Fern (*Hymenophyllum tunbridgense* and *H. unilaterale*) and the Killarney Fern (*Trichomanes radicans*) and its varieties, still greater protection is required than is afforded by ordinary frames or conservatories. These extremely delicate plants only grow, naturally, in the rocky beds of streams, where the atmosphere is continually saturated with moisture, and, in fact, where they are constantly bedewed with spray. Hence, a few minutes' exposure to a dry atmosphere shrivels up their thin, pellucid fronds, and prolonged exposure is fatal. To meet this state of matters baffled both the botanists of old who desired to transmit living plants from place to place, and the Fern-lovers who longed to cultivate them, until, at last, Mr. H. Ward circumvented the difficulty by the invention of what is now, and ever will be, known as the Wardian Case.

This, as everybody, presumably, knows, is a glass, almost airtight, case, covering a receptacle for soil and drainage. The water supplied is prevented from escaping altogether by evaporation, since it is condensed upon the glass, and runs down to the soil to be evaporated again; hence, the air and

soil are kept constantly damp, though a circulation is maintained which prevents stagnation—the result being precisely what the Filmy Ferns require. The principle once grasped, it was seen that ordinary bell-glasses afford the same conditions of growth, so that a round, red, earthenware pan, with a bell-glass fitting neatly into it, forms a cheap and handy Wardian case. It will be seen that, even with these water-loving Ferns, drainage is as requisite as with the others; hence, in starting a Wardian case, or bell-glass substitute, a good substratum of broken crocks and bits of brick should be put in first, over that some fibry material or sphagnum moss, and upon that a rough mixture of peat and sand. The plants should be pegged down upon this, a little more sand sifted over them, and then a good heavy shower from the rose of a watering-pot given, to wash the sand well in and bed the plant comfortably. See that your bell-glass or case doors fit close, and leave the plants alone for a week at least. The Killarney Fern, thus treated, will form a delightful object in time; its motto is, generally, "slow but sure." The Hymenophyllums are pretty and moss-like, but comparatively insignificant.

We have been very successful in the culture of the Killarney Fern in a glass milk-dish about 24in. diameter, covered by a 20in. bell-glass. We half filled the dish with large pieces of flower-pots, arranged as hollowly as possible; on these we put a number of small pieces of brick, then a layer of sphagnum. We then planted the Fern in a red earthenware pan, which we stood in the centre, packing it round with living moss, watering it thoroughly until about 1in. of water stood in the dish among the drainage. The bell-glass was then put on, and silver sand poured round the rim of the glass dish outside, and wetted until it was bedded tightly. The result is all that could be desired, and, practically, no attention at all is requisite, the plant thriving without having been watered in any way for many months. To all appearances it would stand for a year or two without requiring more water.

A very small *Todea superba* we treated in the same manner

grew in such a surprising fashion that the second year it filled the bell-glass completely, and had to be shifted; while its brethren of the same batch, in a close frame, were still in thumb-pots.

For a shady window—*i.e.*, one facing north or east—a most lovely ornament can thus be established, involving the least possible trouble. Even gas, under such conditions, does no harm.

We have also found that an ordinary Wardian case, fitted with a watertight zinc bottom, holding about 2in. of water, in which small thumb-pots were reversed to serve as supports for pots and pans containing choice varieties of Filmy Ferns, answered admirably, the water being drawn up by capillary attraction from the lower pots into the upper, and a congenial humidity being always maintained for months together, without any attention worthy the name. *Trichomanes reniforme*—a very rare New Zealand cousin of the Killarney Fern, but its very antipodes in appearance—thrives apace under this treatment.

CHAPTER VII.

FERN FOES, AND HOW TO FIGHT THEM.

FERNS, when grown under thoroughly congenial conditions, have but few enemies, as will be evident to every Fern-hunter if he turns his attention specially to the point; directly, however, natural conditions are departed from, there are a thousand-and-one foes ready to take advantage of the thereby weakened constitution. The coolest possible temperature during the summer is the panacea for most of the ills that British Ferns are heir to. This granted, the chief enemies to guard against will be slugs, snails, leather-coated grubs (*i.e.*, of the daddy longlegs), and last, but by no means least, caterpillars.

With regard to slugs and the ordinary large snails, a determination to find and kill whenever their shiny track is seen will speedily have the desired effect. Care, too, must be taken when collecting moss, &c., for use in the Fernery, not to import also a new batch of eggs, with the inevitable result of a new spell of hunting when they are hatched. Some of the small snails, especially one tiny, shiny, black, flat, spiral-shelled fellow, which brings tears into its murderer's eyes by the pungent scent of onions borne upon its expiring breath,

must be searched for assiduously if growing fronds—even large ones—are found to stop short in their growth and topple over, as it is very fond of eating its way into the base of the frond, and thus doing fatal injury, not necessarily to the plant, but to its symmetry. Fronds attacked by this marauder remain attached to the crown, being merely bored through the centre; hence its ravages can be discriminated from those of the next foe on our list.

The leather-coated grub of the daddy longlegs resembles a small, dull black sausage, about 1in. long, when full grown. It betrays its unwelcome presence by the same sort of attack as the little snail aforesaid, but on a larger scale: a promising plant is suddenly found with most of the young, rising fronds nipped cleanly off, and lying loose. The enemy will not be far away; he is principally a night-feeder, and makes his lair close to his larder. The best and securest plan is to lift the plant bodily out of the soil, with as much earth as possible. Trowel down the sides of the hole, to see if the vermin is there; if not, he or they—there are often two or three together—will be in the ball, and will probably drop out if it be loosened and shaken. When they do make their appearance, a powerful electric shock, or the heel of a boot, with a man in it, are the best things to apply; we usually adopt the latter.

Slugs, snails, and grubs we have seen how to deal with; their ravages can generally be checked before much damage is done, because, having a comparatively long life, and plenty of time to do havoc in, they are leisurely in their work—have a gentlemanly meal, and a long snooze, and so on. Caterpillars, however, whose lease of destruction is a short one, have no such redeeming characteristics; they are greedy, never know when they have had enough, and, moreover, obtain our hospitality under the falsest of false pretences. We are charmed, for instance, during the summer, by the visit to our Fernery of two or three pretty butterflies, or silvery moths, which have flown in through the ventilator, and which we charitably assist in their efforts to escape. A poetical little episode! Yes, indeed, but our poetical visitors have doubtless left a more prosaic legacy behind, which in August betrays

its presence by a few tiny holes here and there in the best fronds of our pet plants—tiny holes to-day, so tiny, indeed, that they escape our notice, as also, of course, do the tiny, wriggling little wretches under the fronds, who are just beginning to whet their baby teeth. Next day the holes are tolerably large—our pet Fern is spoilt, and so is that special batch of caterpillars. Butterflies and moths are, however, in one respect, models of foresight: they never put all their eggs in one basket—their progeny, also, generally scatter soon after hatching; hence, in the most carefully-watched Fernery, a series of such discoveries as above may be expected, since it is only by the damage done that the foe is discovered. With constant personal care, however, the evil may not go far; but go out of town for a week or two, leave somebody else in charge, and the caterpillar gets his chance, evolution, in his opinion, having doubtless arranged autumnal holidays with a view to his continued existence. When you return, it is possible that you will find a choice collection of rags and tatters of dilapidated Fern fronds, and a fine, fat army of full-sized, green caterpillars roosting upon the ruins, and busily grinding up the remnants into future butterflies, your pet plants resembling precisely Paddy's old coat—*i.e.*, composed principally of fresh air. The caterpillar, in fact, begins dinner when he is hatched, and finishes it when he turns himself into a chrysalis, his only pause being when his garments grow too tight, and he has to throw them off and don a larger suit to accommodate the remaining courses of his banquet. From the above it will be gathered that prevention is better than cure, and that all care should be taken to exclude moths and butterflies, or to destroy them immediately they appear.

Woodlice should be kept under, for though they feed principally on dead matter, they occasionally transgress, and punish some of the smaller-growing Ferns.

The foregoing are the chief enemies to the attacks of which healthy British Ferns are subjected; with ordinary care they can easily be kept under, while, under many conditions—such as in dwelling-houses—they are rarely seen.

Green fly, thrips, scale, red spider, *et hoc genus omne*, are by-products of uncongenial culture—too much heat or draughts, scarcity of light, or some such weakening cause. This last alone is a potent source of weakly growth; for, barring direct sunshine, the plants cannot have too much daylight. If, then, any of these pests make their appearance, it will be endless labour merely to examine and clean the plants, and a comparatively short task to clear the field of the foe by starving them out—a really healthy plant affording them no support.

There is another insect, which mainly affects the Lady Fern, and which, apparently, lays its eggs in the crowns, so that they rise with, and hatch upon, the new fronds in the spring. This is a smallish, semi-transparent, green fly—in its younger stages the hinder half of the body being brownish-green; in shape it is flattish, about $\frac{1}{16}$in. long, and nearly as broad—"Norfolk Howard" pattern. It is easily discriminated from the aphis, or common green fly, as it runs about swiftly. It is a voracious sap feeder, and speedily turns the whole plant a whitish-green. About July it is transformed into a shining, hard, brown insect, bearing much superficial resemblance to a flea, of which, we believe one of the sexes has the power of flight. This seems to thrive most where light is somewhat scanty—which indicates the remedy. If it makes its appearance, a careful search for the first spring broods will check the evil materially.

The last insect-pest we shall deal with is, we believe, a comparatively new importation. This is a white, or greenish-white, fly, about $\frac{3}{16}$in. long, with a strong resemblance—under a lens—to the locust family. It has a peculiarly abrupt, erratic, snipe-like flight, darting instantaneously from one plant to another when disturbed, and settling almost invariably on the under side of the frond, at a point some distance from where it seemed to alight. This fly of late years has become a great nuisance, since it attacks even out-of-door plants of all sorts, healthy or otherwise, and disfigures them by gnawing the outer skin of the frond, or leaves and causing unsightly, white patches.

Unfortunately, it is not merely a nuisance in its flying state—which it assumes about July—but, during the earlier months of the year, the eggs laid in the preceding autumn hatch, and produce a great number of small, brownish insects, of sluggish habit, which feed upon the fronds in the same way as their parent. At this period, therefore, it is well to examine all the evergreen Ferns, and carefully sponge off the future flitters. If any are left to attain the flying stage, a second generation may confidently be looked for in the autumn. The deciduous Ferns remain untouched until the insects fly about, the eggs, if any are laid, perishing on the dead fronds.

Fumigation with tobacco smoke, if very judiciously done, will do much to reduce the ranks of these flying and creeping foes, but in unskilful hands is very apt to damage the young and tender growth of the Ferns themselves, especially the Maidenhairs; frequent slight fumigation is therefore advisable, rather than a sudden drastic application in full force.

The Fern foes so far described are all comparatively small, and only formidable by their numbers. Individually, the intrepid Fern-lover, armed with a finger and thumb, and the boot-heel already indicated, has a very fair chance of coming off the victor in a scrimmage at close quarters. There are, however, some which grow to as much as 5ft. or 6ft. high, and are even worse than the caterpillar in the ravages they commit, several British species having, indeed, been all but annihilated by them. These assume various forms; sometimes they look like an ordinary rustic, armed with a sack and a trowel, who leaves a lovely Fern-clad lane a veritable wreck before his appetite is satiated; sometimes they look like tourists, who, having the audacity to dub themselves Fern-lovers, make similar raids with even less excuse, their prey in most cases being destined to a slow death by neglect or careless treatment; or probably, when later on in their tours the freshness of the plants has gone, they are abandoned as useless impedimenta, and replaced by the proceeds of another piece of vandalism.

These, in one or other of their varied forms, are mainly

the foes of our wild Ferns; but our private collections are not always safe from spoilers of allied character. We have heard of them assuming the shape of gardeners of low degree, whose ravages embrace plants, pots, and all, nothing being left but a gap in the collection, and an assumed look of bewilderment on the spoiler's face as to "Who could ha' done it."

Sometimes they appear in the guise of nice young ladies, who, professing intense admiration of your pets, are made the temporarily happy possessors of a few choice forms, which, when inquired after in a week or two, are found to have died in a most mysterious and incomprehensible fashion; the fact being that your advice regarding their culture went in at one ear and out at the other; or Mary the maid stupidly forgot to water them; or they could not be planted for a few days, as the gardener was busy, and so they got dry, &c., the result being almost invariably the same as in the case of the caterpillars, only more thorough. We are hardly prepared to suggest exterminatory remedies for the several Fern foes just described, especially the last of all, though their attacks are particularly insidious, and difficult to evade; we can only hope that our little book may convert some of them into true Fern-lovers, and, by inculcating a taste for the varieties, render the wholesale plunder of the common—but still beautiful—forms a thing of the past; just as no one would dream of transplanting wild Roses, wild Pansies, &c., to his garden, who has become acquainted with their far more lovely cultivated sisters.

THE

FERN FAMILIES OF BRITAIN,

AND THEIR

CHOICEST VARIETIES.

THE

FERN FAMILIES OF BRITAIN,

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CHAPTER I.

INTRODUCTION.

HAVING, in the preceding section, given a description of the predominant types of variation, together with practical hints regarding their general culture and propagation, and other particulars connected with the subject, which we trust our readers will have found interesting, our next task is that of giving, with the aid of illustrations from Nature, such descriptions of the various Fern families indigenous to our country as will enable any of our readers to recognise them when found; while the woodcuts and descriptions of the variations will give them a fairly clear idea of what they may possibly light upon, if their quest be only sufficiently earnest

and persevering, and of the forms in cultivation which are most desirable to procure as the *nucleus* of a collection. We are particular in italicising the word nucleus, in order to impress upon our readers what we have already stated regarding the merely representative nature of the types we have selected, and the existence of a great number of other forms which, though fully worthy of specification on the score of distinctness and beauty, our space limit has forced us to exclude. For some of these we can only refer to the published catalogues of the few nurserymen who make a specialty of British Ferns. Extended experience will bring with it a knowledge of other varieties, amongst them some of the very choicest, which are only procurable by way of favour or exchange among the confraternity of amateur Fern-lovers who raise or find new forms on their own account.

The special cultural remarks attached to each species will be found to be Nature's own teaching, and the logical outcome of a study of their habits and habitats.

CHAPTER II.

THE MAIDENHAIR FERN

(*Adiantum Capillus-Veneris*).

AS the allied form of Maidenhair Fern (*A. cuneatum*, wedge-shaped), a native of Southern Europe, forms so well-known a type of the species generally, we may fairly refer to it in describing the British species, which differs mainly in its bolder growth, the pinnæ being somewhat semicircular in shape instead of triangular, and considerably larger and fewer than in *A. cuneatum*. The spore-heaps appear in semicircular patches on the edges of the fronds, which are turned back so as to form a cover (*indusium*).

This lovely Fern is only found on the warmest coasts of the British Isles, and being rather tender, is not adapted to stand more than a few degrees of frost. In its natural haunts it is found growing in the crevices, sometimes very deep ones, of sea cliffs, and on some parts of the Irish coast grows very luxuriantly. It requires a well-drained, gritty soil, and, as its habitats indicate, needs a little warmth to induce free growth.

It has afforded several varieties of great beauty.

A. C.-V. cornubiense (so-called because found wild in Cornwall) represents the plumose form of the species, and is a very close imitation of the well-known *A. Farleyense* (regarded, by Baker, as a variety of *A. tenerum*), the pinnæ being very large, and deeply divided or fringed on the edges, precisely

in the same fashion as that lovely exotic, from which, indeed, it can only be discriminated by its smaller size.

A. C.-V. daphnites (glistening). See Fig. 15. Another very beautiful form, with extra large pinnæ, somewhat crowded and blended together, so as to form a close approach to cresting at tips of fronds and pinnæ. A plant of this type in the

Fig. 15.—Adiantum Capillus-Veneris daphnites.

possession of Mr. Greenwood Pim, of Dublin, has become proliferous, bearing innumerable little plants in clusters on the edges of the pinnæ, in the usual place of the spores.

A. C.-V. magnificum (magnificent). A very bold and handsome form, with much larger pinnæ than the common type.

A. C.-V. plumosum (feathery). A handsome form, found in North Devon, cut as in *cornubiense*, but with the edges irregularly extended by acute and long projections.

CHAPTER III.

THE PARSLEY FERN

(*Allosorus crispus.* Syn. *Cryptogramme crispa*).

THE resemblance of this Fern to parsley is rather fanciful than real (see Fig. 16), and can only be seen at a distance, when its tufty habit and small size somewhat justify the name. It is a very pretty Fern when grown properly, and is the sole known representative of the species. The fronds are thrice divided—*i.e.*, into pinnæ, pinnules, and pinnulets—the last being slightly saw-toothed on the barren fronds, which are leafier and less erect than the fertile ones, the backs of which are entirely covered by the spore-heaps. In its native habitats it is always found pushing its way through the *débris* of weathered rocks, or nestling in the chinks of stone dykes. The best, and, indeed, the only, way to grow it well is to plant it in some gritty, open compost of broken slate and fibry loam, and then put a handful or so of broken stones over and about the crown—burying it, in fact, in these, but not in soil. The fronds will speedily find their way through, and form a pretty clump, which will stand any amount of sunshine with impunity, if the soil is kept moist. The only good variety found, so far, is

A. c. cristata (crested), a beautifully crested form, found

at Seathwaite, in 1874, in which the fronds form small balls

FIG. 16.—ALLOSORUS CRISPUS.

of delicate, moss-like cresting. It is very rare, being apparently tenderer than the normal form.

PLATE II. VARIETIES OF THE SPLEENWORTS AND THE LADY FERN

PLATE II.

Varieties of the Spleenworts

(*Asplenium*).

Fig.
2. *Asplenium marinum plumosum* (pinna).
7. „ „ *capitatum.*
10. „ *Adiantum-nigrum grandiceps.*
14. „ *Trichomanes incisum,* Clapham.
16. „ „ *ramo-cristatum.*
17. „ „ *cristatum.*

Varieties of the Lady Fern

(*Athyrium Filix-fœmina.* Syn. *Asplenium Filix-fœmina*).

Fig.
1. *Athyrium Filix-fœmina Victoriæ.*
3. „ „ *splendens* (pinna).
4. „ „ *Kalothrix* (top half frond).
5. „ „ *Frizelliæ ramosissimum.*
6. „ „ *Frizelliæ.*
8. „ „ *plumosum,* Horsfall (pinna).
9. „ „ *pulcherrimum* (pinnæ).
11. „ „ *Frizelliæ cristatum* (top half frond).
12. „ „ *Clarissima* (pinna).
13. „ „ *acrocladon.*
15. „ „ *glomeratum* (top half frond).
18. „ „ *Vernoniæ cristatum.*
19. „ „ *Frizelliæ ramosum* (crest).

CHAPTER IV.

THE SPLEENWORTS

(*Asplenium*).

OBLONG, pointed heaps of spore-capsules, lying along the midribs of the pinnulets (Fig. 17), provided with a thin, semi-transparent cover, which, however, only very partially hides the matured spore-heaps, distinguish this family. All the members of the family are quite evergreen, and affect principally the chinks and crevices in walls or rocks. There are nine native species, of which separate descriptions follow. The figures in parentheses refer to Plate II.

FIG. 17.—PINNA OF ASPLENIUM ADIANTUM-NIGRUM.

The Black Maidenhair Spleenwort

(*Asplenium Adiantum-nigrum*).

This is the boldest grower amongst the British species. It is found very generally distributed, and grows in sloping hedge-banks, as well as in the crevices of walls, stone dykes, and rocks. The fronds, which grow sometimes to 1ft. and more in length, are narrowly triangular in shape, and twice divided, the pinnules being more or less deeply cut and saw-toothed.

Fig. 18.—Asplenium Adiantum-nigrum grandiceps.

The stalk is about as long as the leafy portion of the frond, and is of a shining black colour—whence the name. The spore-heaps have been already described. The normal form varies considerably, ranging from blunt, rounded pinnæ, to long, narrow, acutely pointed ones, so that it is quite impossible to draw a line between the extreme varieties—*obtusum* and *acutum*—and the common. The best forms of *acutum* are decidedly the most beautiful. Cultivation is easy, all it requires being good drainage and a somewhat gritty compost. Besides the forms already mentioned, some very distinct ones have been found.

A. A.-n. caudifolium (tailed-fronded). This is a very curious form, both frond and pinnæ ending in long tails, and bearing blunt lobes, of a yellow colour, which impart a strange appearance to the plant. This was a wild find on Dartmoor, where some hundreds of plants of it covered a stone wall.

A. A.-n. cristatum (crested). Neatly crested.

A. A.-n. grandiceps (large-crested). See Plate II., 10, and Fig. 18. This was found growing on an old wall in Co. Waterford, Ireland, and has heavy, fan-shaped crests and fan-shaped pinnæ. It is a very pretty plant when well grown. An equally fine form, with crest and pinnæ more deeply cut, was found subsequently in North Devon. Our illustrations represent the Irish find.

A. A.-n. microdon (small-toothed). A very bold-growing form, with large pinnæ hardly subdivided; very distinct.

The Lanceolate Spleenwort

(*Asplenium lanceolatum*).

This very much resembles the Black Maidenhair Spleenwort, but the stalks are lighter coloured, and the leafy part of the frond spear or lance shaped—whence the name. Spore-heaps typical of the family. While there are fronds in process of unfolding, this Fern can easily be discriminated from the preceding species by the divisions keeping their tips tightly rolled up as long as possible, instead of loosening out at a much earlier stage. This is a true wall Fern, and needs corresponding culture. Until very recently there was no crested variety, but at length it has come to light.

A. l. cristatum (crested). Recent wild find, and still young, but heavily and symmetrically crested on tips of frond and pinnæ.

A. l. microdon (small-toothed). Same sport as the *microdon* of *A. Adiantum-nigrum*, which it very closely resembles.

The Sea Spleenwort

(*Asplenium marinum*).

This handsome Fern has thick, leathery fronds, only once divided, the pinnæ bluntly saw-toothed; the fronds are narrow

in the leafy portion, and stalks long; hence it has a graceful, pendent habit of growth. It is usually found on sea cliffs or in sea caves, within the immediate influence of the sea air, and often of the sea water. Like its neighbour the Maidenhair (*Adiantum Capillus-Veneris*), it cannot stand much frost, and, indeed, under cultivation it is dangerous to expose it to any. On the other hand, it stands alone amongst our British Ferns in its capacity of thriving under absolutely tropical treatment, which causes it to grow most luxuriantly. It requires the treatment of rock Ferns—*i.e.*, gritty, porous soil, and thorough drainage—and when well grown is one of the most satisfactory evergreen species. It has afforded several very marked varieties.

A. m. capitatum (headed) (7). A splendid form, bearing a heavy crest on a long stalk almost or quite bare of pinnæ. Found in Yorkshire.

A. m. imbricatum (imbricated). A congested form, with wide pinnæ overlapping each other considerably.

A. m. plumosum (feathery) (2). A very handsome, bold-growing form, twice divided, the pinnæ being very wide and deeply cut, giving the frond a truly plumose character.

A. m. ramosum (branched). The fronds branch several times, and sometimes crest, forming a neat, tufty plant.

The Common Spleenwort

(*Asplenium Trichomanes*).

This very beautiful little Fern (Fig. 19) is of very general distribution, and frequents old walls, stone dykes, chinks and crevices in rocks, and slopes of hedge banks. The fronds are generally small, but under very favourable circumstances sometimes attain 9in. or 10in. in length. The stalks are quite black; the pinnæ roundish, and attached by a minute, jointed stalk; when old they become detached from the main stalk, which exists for a long time afterwards, and forms a distinguishing mark of the species. Soil must be gritty and open. If grown in pots, bear in mind it is a wall Fern, and plant it close to the edge, or between some pieces of porous stone. A good plan

is to bury a flat piece of stone slantingly in the soil, scatter a little compost on it, spread out the roots of the Fern, and just cover them with soil, after which put another flat piece of stone over all, thus leaving the crown in a chink. The crown must not be buried, as Nature's own treatment shows clearly enough. A hundred feet or so of old wall, starred all over with these charming little plants, is a grand hunting ground for the careful eye; and since the Fern, in some localities, is rather variable, the chance of a good find is not so remote as to deserve ignoring.

FIG. 19.—ASPLENIUM TRICHOMANES.

The best forms yet discovered are the following; the figures in parentheses refer to Plate II.

A. T. confluens (confluent), Stabler. This is a very curious sport, the frond being quite leathery; the pinnæ are so close as to overlap at their edges, those near the top of frond being all joined together or confluent. It is also barren, for though apparently spores are abundant, they are imperfect; hence it is rare. It is very strong in growth; fronds nearly 1ft. long.

A. T. cristatum (crested). See Plate II., 17, and Fig. 20. Beautifully tasselled at tpis of fronds; some of the forms in

cultivation bear large, flat crests, fanning out 2in. to 3in. wide. Wild find in several places.

A. T. incisum (deeply cut) (14). This is the most beautiful variety found so far, and is really the plumose form of the species, the small, roundish lobes which constitute the pinnæ of the common form being greatly enlarged and very deeply cut, the subdivisions running out into points.

FIG. 20.—ASPLENIUM TRICHOMANES CRISTATUM.

This has been found wild in several places, but, being always barren, is rare. Mr. Clapham's form is by far the best.

A. T. Mouleii (Moule's). Very distinct, uncrested; pinnæ small and narrow, with wavy edges. Wild find.

A. T. ramo-cristatum (crested-branched) (16). In this form the frond branches more or less before cresting, thereby forming numerous smaller crests, instead of one only, as in *cristatum*. Wild find.

The Green Spleenwort

(*Asplenium viride*).

THIS Fern resembles strongly *A. Trichomanes* in general habit and appearance, but is far more sparingly distributed, and prefers a damper atmosphere and position. It differs in having

a green stalk instead of black, and the pinnæ are not jointed, but firmly set on. It is a difficult Fern to cultivate, thriving for a year or two, and then, as a rule, mysteriously disappearing. Woodlice are its greatest foes. It has only sported a little in irregular ways; or, if good forms have been found, they have not survived removal long, so far as we are aware. A very beautiful dwarf and densely-imbricated form was found, some years since, by Mr. McLean, near Aberfeldy, but perished under cultivation the second year.

The Fountain Spleenwort

(*Asplenium fontanum*).

As will be seen by Fig. 21, this is a very pretty Fern. It is of dwarf habit, and can be grown well under rock Fern treatment. The woodcut gives too good an idea of its habit and general character to need further description. As the most recent British find of this species dates thirty-five years

Fig. 21.—Asplenium fontanum.

back, a new discoverer of a really wild plant will be fortunate. It was always extremely rare. Varieties none, unless we accept as such—which we may do with good authority, though its origin is obscure—

A. f. refractum (bent back). This has much longer and,

comparatively, narrower fronds than the type, and a very different aspect altogether. It also is proliferous, bearing small plants on its stalk, at the junctions of the lower pinnæ.

The Wall-Rue

(*Asplenium Ruta-muraria*).

This, which is one of the smallest of our Ferns, is found almost everywhere on old walls and similar places, its insignificant appearance and difficulty of culture being such safeguards that it is little likely to be eradicated. As its name indicates, it is a thorough wall Fern, and under culture a bit of old wall must be contrived for its accommodation, which can be done by mixing some broken brick, old mortar, and Fern soil together, and planting the Fern in a chink between the pieces. It has afforded some varieties, crested and otherwise, but none that can be considered beautiful.

The Forked Spleenwort

(*Asplenium septentrionale*).

The German Spleenwort

(*Asplenium germanicum*).

We class these two together; the culture of the Wall-rue suits them exactly; they have very simple fronds indeed. The Forked Spleenwort resembles, roughly, a few stiffly-growing grass blades, twice or thrice forked, points slightly saw-toothed, the characteristic Spleenwort spore-heaps running along the middle. In *A. germanicum*, the side divisions are forked again, and, being more numerous, impart a slightly fernier look to the plant. Varieties, none worth mentioning; the common forms are, however, rare enough to constitute a "find" when discovered.

CHAPTER V.

THE CETERACH

(*Ceterach officinarum.* Syn. *Asplenium Ceterach*).

ALTHOUGH closely allied to the Spleenworts, the Ceterach differs from them materially in some respects. Our woodcut (Fig. 22) gives a very good idea of its appearance, and obviates the necessity for detailed description of form and habits. The colour of the fronds is a bluish-green; they are quite evergreen, very leathery, 5in. to 6in. long, and are peculiarly characterised by the backs being densely covered by a mass of reddish-brown scales, which hide the spore-heaps almost entirely. Hence it is sometimes termed the Scaly Spleenwort.

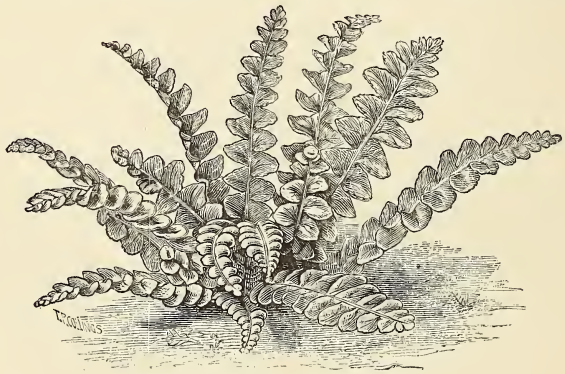

Fig. 22.—Ceterach officinarum.

It is never found growing in the soil, but frequents the *sunny* sides of old walls (another peculiarity, which marks it off from most other Ferns), and in cultivation it will only thrive when treated accordingly—*i.e.*, plenty of old mortar in soil, good drainage, and ample light. There are no very marked varieties.

CHAPTER VI.

THE LADY FERN

(*Athyrium Filix-fœmina.* Syn. *Asplenium Filix-fœmina*).

WE now come to a species which, besides being very beautiful in its normal state, is so subject to variation that possibly none exceed it in the number of forms to which it has given rise, both under natural conditions and artificial culture. The fronds are large, and of spear-shaped outline. They are three or even four times divided, and spring shuttlecock fashion from a central crown. The spore-heaps resemble somewhat those of the Aspleniums, but are curved like a sickle, and imperfectly covered. In some varieties, such as the plumose, which in this family are usually more or less fertile, there is no cover at all. This is also the case in *A. F.-f. alpestre,* which on that account is classed amongst the Polypodies, from which, however, it differs in all other respects, resembling a Lady Fern exactly, with which, therefore, we take the liberty of classing it, especially since, as we have seen, there are acknowledged forms of Lady Fern with the same peculiarity precisely.

This lovely Fern delights in moist, sheltered, shady nooks, and likes, as it were, to stand on the bank and bathe its feet in the stream. When its tastes are fully consulted, it grows to a large size, between 3ft. and 4ft. high, sending up a multitude of huge, feathery fronds of, we should have said, the utmost delicacy, had we not in our mind's eye the surpassingly delicate forms of some of the varieties.

Culture of this Fern is simple enough, since it will grow in any soil, provided only ample room be given for the roots, ample water to keep them moist, and sufficient protection from the wind and the weather to give the fronds a fair chance of remaining uninjured. A very short exposure to a strong draught while the fronds are expanding will cause the growing cells on the edges to be ruptured, and the result will be visible in imperfect fronds throughout the season. This Fern is not an evergreen, the fronds perishing in the autumn, whether protected or not. About April, however, the crown will be seen to swell, and in an incredibly short space of time, if the weather be warm, a brand new full-sized plant springs up and develops like a fountain of verdure.

The varieties, as we have said, are innumerable; many, however, are more curious than pretty, and, considering the wealth of really fine and perfect forms, should not be cultivated. The following are some of the best. The figures in parentheses refer to Plate II.

A. F.-f. acrocladon (summit-branched) (13). This would represent the acme of cresting had it not been surpassed by some of its offspring. It resembles balls of moss upon short, branchy stems. It was found in a small state by the roadside on a Yorkshire moor, and was unique for many years, when spores were found, from which a very mixed progeny resulted, the majority inferior and worthless, some equal, and, in fact, reproductions of the parent form, and a few quite new varieties, the best of which are

A. F.-f. acr. unco-glomeratum (hook-clustered), as densely crested as the parent, but with a distinct character in the ultimate divisions.

A. F.-f. acr. velutinum (velvety), much more finely divided and dwarfer, resembling balls of very fine moss.

A. F.-f. acrocladon has also yielded several other very beautiful forms from its spores, viz.: *magnicapitatum*, *laciniato-acrocladon*, *ramosissimum fimbriatum*, and *acrocladon densum*, which, however, though distinct, are too subtle in their differences to be popularly described, and hence are merely mentioned here as being too good to be ignored.

A. F.-f. Clarissima (Clara's) (12). This Fern has achieved world-wide fame, having furnished material for the first discovery of a new method of reproduction in the Fern family, for the details of which we refer our botanical readers to our concluding pages, whither we have banished the subject on the score of its incorrigibly technical character. The variety is very beautiful, the subdivisions being extremely long and slender; the plant grows to a huge size for a Lady Fern, the fronds sometimes measuring 2ft. across, and long in proportion. It was a wild find in North Devon and remained unpropagated (except once by a division) for more than twenty years, its supposed spores yielding no results. Eventually it was found to reproduce itself under special treatment in a way hitherto quite unknown, the prothalli (see Appendix on "Apospory") springing direct from the fronds—being, in fact, produced instead of spores.

A. F.-f. congestum (crowded). Syn. **Grantiæ** (Grant's). A very dense-growing form, the pinnæ and sub-divisions being all crowded together and overlapping. Very distinct and constant.

A. F.-f. cong. cristatum (crested). Syn. **Findlayanum** (Findlay's). The same sport, but crested at tips of frond and pinnæ.

A. F.-f. cong. minus (lesser). Syn. **Edwardsii** (Edwards'). A very dwarf, compressed form, of more delicate texture than the last, and with curled and pointed divisions. A little gem.

A. F.-f. corymbiferum (corymb-bearing), James. This has huge, ball-like masses of finely-divided cresting at top of fronds and pinnæ; one of the boldest and handsomest crested forms.

A. F.-f. crispum (curled). A dwarf form, much branched and crested, somewhat in the style of *acrocladon*, but less dense; it also spreads freely, and soon forms large tufts. Wild find.

A. F.-f. cristatum (crested). There are many distinct forms which can only be described as crested, bearing more or less dense tassels at tips of fronds and pinnæ. They are all beautiful.

A. F.-f. Elworthii (Elworth's). Crested throughout à la *percristatum* (J. S. Cousens), but with wider and flatter crests and coarser look. Wild find.

A. F.-f. Fieldiæ (Field's). Somewhat akin to *Frizelliæ*, but

with oblong pinnules set on in radiating clusters of two or three, instead of being compressed into balls; tips of fronds end abruptly.

A. F.-f. Frizelliæ (Frizell's) (6). This was a wild find, and is a most extraordinary vagary, the pinnæ all being contracted into flattish balls, so that the fronds, when full length, would be little more than ½in. wide, resembling a huge form of *Asplenium Trichomanes* more than anything else. The spores of this have yielded innumerable sub-varieties, the great majority of which are inconstant; very provokingly so, since a plant may stand and flourish steadfastly for several years, and then, apparently without any reason, throw up fronds in which the common form and the variety are mixed up anyhow, rendering the plant worthless.

A. F.-f. Friz. cristatum (crested) (11). Narrow fronds, true to type, but expanding at the tips into a splendid, nearly circular, radiating crest, heavy and dense.

A. F.-f. Friz. ramosissimum (extremely branched) (5). A pretty and constant form, in which the fronds branch several times close to the ground, forming a dense, close tuft of small fronds true to the type.

A. F.-f. Friz. ramosum (branched) (19). Syn. **Appleby-anum** (Appleby's). A full-sized variety, in which the tip of the frond branches out into a broad, flat crest, sometimes 5in. to 6in. wide, all the divisions bearing the contracted pinnæ of the type.

A. F.-f. Girdlestoneii (Girdlestone's). Wild find. Exceedingly handsome. The pinnules next the main stem are wanting, but those on the remainder of the pinnæ stalks are very long, slender, and numerous; they are, in their turn, near their bases devoid of pinnulets, which are again deeply cut and numerous, giving the frond a very rich and luxuriant appearance peculiar to this variety.

A. F.-f. glomeratum (clustered) (15). A distinct form, cresting in same manner as *corymbiferum* (James), but more heavily.

A. F.-f. Kalothrix (beautiful hair) (4). This stands alone among our British varieties for delicate beauty. It is not

crested, but all the divisions are as fine as hair—hence its name. Besides this fine division, it has a peculiarly glassy translucency and silky lustre. When carefully sheltered from sun and wind, it grows to a fair size, and looks as if formed of spun glass or silk. It originated as a seedling from a plumose form, and occasionally betrays its origin by a pinnule, a pinna, or even an entire frond of the parent form making its appearance. Decidedly no collection should be without this. None of the other species have yielded a parallel sport.

A. F.-f. orbiculare (orb-shaped). Huge, spherical crests, like balls of moss, size of cricket balls; pinnæ few and small.

A. F.-f. percristatum (much crested), J. S. Cousens. In this the pinnules, as well as the fronds and pinnæ, are distinctly and symmetrically tasselled, giving the frond a very rich and elegant appearance. Accidental seedling at Wanstead.

A. F.-f. plumosum (feathery), Horsfall (8). A true plumose form, found in Yorkshire; very finely cut, and of graceful habit, somewhat more drooping than the other plumose forms. A very similar find to this yielded *Kalothrix* as a seedling.

A. F.-f. plumosum, Stansfield. A seedling from *Kalothrix*, and therefore, presumably, a reversion. Considered by the raiser to surpass the Horsfall variety.

A. F.-f. plumosum, Axminster. (Plate I., 2). A wild find at Axminster. It is of robuster growth and habit than the preceding forms, attaining the fullest dimensions of the common Lady Fern. It is most delicately divided, and has been found to produce not only spores, but also bulbils, on the under side of the fronds (an almost unique case of bulbils being found there), from which plants have been raised. A spore of this gave

A. F.-f. plum. elegans (elegant), Parsons (Plate I., 3), in which the division of the fronds is carried much farther, so that they resemble very delicate lace. Nature, however, not yet content with her handiwork, has endowed the spores of this Fern with the peculiar capacity of yielding a majority of heavily crested plants, disfigured, however, and spoilt generally, by gaps and irregularities. One spore, however, specially gifted, has yielded

A. F.-f. plum. cristatum superbum (superb-crested) (Plate I., 4), by far the most beautiful plumose Athyrium yet raised, an altogether new character being developed in conjunction with the plumose. A reference to Plate I. will show, in a very clear way, how, in three generations, this last form has been evolved in three strides from the common Lady Fern, also figured for comparison (Plate I., 1).

A. F.-f. plum. divaricatum (divaricate). A distinct plumose form in which the spring fronds are much more leafy than the later ones. Upon this variety bulbils also appear in conjunction with the spores.

A. F.-f. plum. multifidum (much-cleft). A finely tasselled variety of the Axminster *plumosum*.

A. F.-f. plumosum, Barnes. Very finely cut plumose form; spores extremely rare. The most barren *plumosum* yet found in this family.

A. F.-f. Pritchardii (Pritchard's). Same as *Fieldiæ*, but fronds taper off to a point. Very apt to revert more or less to common form.

A. F.-f. pulcherrimum (very beautiful) (9). Rightly named beautiful; pinnæ very wide and tapering to an acute point; pinnules delicately subdivided and finely saw-toothed.

A. F.-f. ramulosissima (many-branched). Fronds branch many times close to base, each thus forming a fan-shaped bunch of fronds with numerous crested tips; pinnæ crested also.

A. F.-f. reflexum (reflexed). All the pinnules are curved backwards, forming the pinnæ into tapering tubes with curled tips. Very curious, but hardly beautiful.

A. F.-f. regale (royal). An extremely fine form, with finely-cut cresting throughout, raised by Mr. Barnes.

A. F.-f. setigerum (bristle-bearing). Fronds so finely divided that the ultimate divisions are like bristles—whence the name; very handsome, uncrested. The spores of this form yield crested plants, which, however, almost invariably revert, sooner or later, to the parent form.

A. F.-f. set. cristatum (crested). A constant crested seedling of above.

A. F.-f. splendens (splendid) (3). A very beautifully crested, somewhat plumose form; pinnules crested throughout.

A. F.-f. Vernoniæ (Vernon's). A very beautiful wild find, of normal outline, but with peculiarly crisped and wavy divisions, giving it a most distinct character. Its spores have yielded

A. F.-f. Vern. corymbiferum (corymb-bearing), a densely ball-crested dwarf form.

A. F.-f. Vern. cristatum (crested), Jones (18), with flat crests to frond and pinnæ; extremely neat and pretty.

A. F.-f. Victoriæ (Victoria's) (1). This Fern, which was found wild by a roadside in Scotland, is one of the most extraordinary sports yet discovered or raised; it may indeed be classed as quite unparalleled, since not only are all its extremities very slenderly and symmetrically tasselled in a style of its own, but all the divisions, even to the pinnules, are in duplicate, and set on at nearly right angles to each other. The fronds and the divisions are also very narrow, and hence instead of presenting a crowded appearance, the frond looks like a series of beautifully tasselled crosses radiating from the central stalk and gradually diminishing towards the tip, where they merge into a dense, terminal tassel, of many slender strands, tasselled again at their tips. As repeated search in the locality led to no discovery of other plants like it or of an intermediate character, and the form has never been re-discovered elsewhere, we are forced to the conclusion that this marvellous caprice of Nature is the direct offspring of a common Lady Fern, though we can form no conception of the subtle influence which could so have affected the presumably solitary spore, and caused it to depart so widely from the parent form in the plant to which it gave birth. The spores of *Victoriæ* are quite constant, but generally yield plants of somewhat coarser character, though of same type. No other Fern has yet been discovered varying in same way. Mr. E. J. Lowe has raised from this

A. F.-f. Vict. gracile (slender), a slenderer form throughout.

A. F.-f. Vict. magnificum (magnificent). A robust form with the twin character more distinctly marked in the pinnules, they being longer than in the original find.

PLATE III.

Varieties of the Hard Fern

(*Blechnum Spicant.* Syn. *Lomaria Spicant*).

Fig.

1. *Blechnum Spicant* (normal form).
2. „ „ *polydactylum.*
3. „ „ *imbricato-cristatum.*
4. „ „ *cristatum* (*ramosum*, Kinahan).
5. „ „ *trinervium*, Hodgson.
6. „ „ *ramo-cristatum*, Druery.
7. „ „ *glomeratum* (*Maunderii*).
8. „ „ *ramo-cristatum*, Druery (*robustum*).
9. „ „ *Aitkenianum.*
10. „ „ *cladophorum.*
11. „ „ *trinervium coronans*, Barnes (*multifurcatum*).
12. „ „ *lineare*, Barnes.
13. „ „ *concinnum*, Druery.
14. „ „ *congestum*, Druery.
15. „ „ *serratum*, Airey, No. 2.
16. „ „ *sub-plumosum*, Phillips.
17. „ „ *imbricatum*, Snell.
18. „ „ *serratum*, Airey, No. 1 (*plumosum*).
19. „ „ *contractum.*

PLATE III. VARIETIES OF THE HARD FERN.

CHAPTER VII.

THE HARD FERN.

(*Blechnum Spicant.* Syn. *Lomaria Spicant*).

EXCEPT in limestone districts, this species is very generally distributed, and is one of the most easily distinguished of all the British Ferns, as, with the exception of the totally different Parsley Fern, it is the only one which throws up two distinct sorts of fronds—viz., barren ones, which are drooping and divided once, like a double comb with broad, blunt teeth all but touching each other; and fertile ones, which are fewer and much longer, bearing considerably narrower divisions with comparatively wide spaces between, the leafy portion being replaced by the spore-heaps and their protecting cover. This very beautiful Fern is a thorough evergreen, though the comparatively few fertile fronds perish when the spores are shed in the late autumn; and being of a tough nature, with a smooth, glossy surface, it retains its beauty quite through the winter. It is found growing most luxuriantly in deep, damp dells, where leaf mould forms the entire soil and water is plentiful. Here the fertile fronds attain a height of sometimes 3ft. In some spots in woods it may be found literally carpeting the ground in a small state, rooting into absolute clay; and since in pot culture pure leaf mould is apt in time

to rot and lose body, we have found the best compost to consist of an admixture of small nodules of clay or brick-earth, leaf mould, and sand, in the proportion of two, four, and one respectively. Hard water must be carefully avoided with this Fern; it is certain death in a very short time. From the foregoing description of its favourite haunts, it will be seen that plenty of water and shade are necessary. With these and ordinary care the Blechnum may be made one of the prettiest pot plants existing—the two sorts of fronds contrasting well, and adding greatly to its ornamental character. It has yielded a number of very marked varieties, in nearly all of which the same distinctive difference in its fronds is maintained. The figures in parentheses refer to Plate III.

B. S. Aitkenianum (Aitken's) (9). Wild find. Bears large, flat, branching crests, while the side divisions are much reduced. Curious, but handsome.

B. S. cladophorum (branch-bearing) (10). This divides and crests in quite a different way, no two fronds being alike; they are also slenderer in outline, and often curved like a sickle.

B. S. concinnum (neat), Druery (13). Found on Exmoor, 1881. Very distinct and beautiful. The pinnæ of the barren fronds are contracted symmetrically into small, round, toothed lobes like small scallop shells closely set together. The fertile fronds are merely thin sticks with small knobs bearing the spores. When grown soft in a close frame, the pinnæ occasionally lengthen here and there; but grown hard, the fronds maintain their symmetry.

B. S. congestum (crowded), Druery (14). Dartmoor find. Normal form condensed into half size; pinnæ rather crowded.

B. S. crispissimum (much crisped). Extremely dwarf and congested; a decent-sized normal plant being, as it were, condensed into one with hard, horny fronds, 3in. or 4in. long; pinnæ squeezed tightly together. Very rare and pretty.

B. S. contractum (contracted) (19). A similar form, with very short pinnæ half way up, rest usual length. There are two forms of this—one quite normal all but the contraction, the other much slenderer in make, as illustrated. Good.

B. S. cristatum (crested) (4). Syn. **ramosum** (branched), Kinahan. Wild find, Ireland. Fronds narrow at bottom, gradually widening and branching several times near the top, each branch being somewhat curly and bearing a crest; the pinnæ are square tipped, *i.e.*, incipiently crested, but do not divide.

B. S. cristatum (crested), Stansfield. A very handsome branched and crested form, pinnæ decidedly crested. Wild find, Yorkshire.

B. S. imbricatum (imbricated), Snell (17). Condensation carried a step farther than in *congestum*; fronds thick and leathery; pinnæ very crowded and overlapping.

B. S. imbricato-cristatum (imbricate-crested) (3). Pinnæ overlapping slightly and dilated at tips like the last; fronds terminating in small, neat crests.

B. S. lineare (linear), Barnes (12). Outline of fronds same as in *concinnum*, but lobes smooth edged, or nearly so, and confluent, *i.e.*, running together for the greater part of the length, and forming almost strap-like fronds.

B. S. paradoxum (paradoxical). A unique sport, bearing a third set of pinnæ along the midrib. Found some years ago in Westmoreland.

B. S. polydactylum (many-fingered) (2). Fronds more or less, but constantly, divided at tips. This has been found on many occasions. As it grows full normal size, a robust specimen is very handsome. We figure one we found in North Devon.

B. S. ramo-cristatum (branch-crested), Maunder. A beautifully branched and crested wild find. Fronds divide near the base several times, spread out like a fan, and bear wide crests on each division. This does not grow very large, but it is the best crested wild find of the species. It has, however, been far surpassed by two of its direct offspring and several of its grandchildren.

B. S. glomeratum (clustered) (7). Syn. **Maunderii** (Maunder's). From a spore of above, dwarf and densely crested as possible, a well grown plant being a perfect ball of moss-like appearance, but hard to the touch. It occasionally throws

up seemingly fertile fronds; but, we believe, the spores fail to perfect, as is the case in many of these extremely divided forms, the requisite vigour apparently running to leafage.

B. S. ramo-cristatum (branch-crested), Druery (8). Raised from *ramo-cristatum* (Maunder). An exceedingly robust form, divided and crested in same way as the parent, but on an altogether larger and more luxuriant scale. Size possibly is the only difference, but that is striking. This bears spores profusely, and in its turn has yielded some offspring of different

FIG. 23.—BLECHNUM SPICANT TRINERVIUM CORONANS, Barnes.

character, four or five distinct types resulting from one sowing amongst, strange to relate, considering the advanced variation of the parents, fully 90 per cent. of absolutely common Hard Ferns, between which and the best types there are grades ranging from the merest rudiment of a crest up to densely crested and divided types surpassing the parent, but which at date of writing are mostly too young to christen. One form is figured (6). It is to be observed that, various as the grades are, each plant is true throughout, even where the variation is extremely slight.

B. S. serratum (saw-edged), Airey, Nos. 1 and 2. These are two splendid varieties which, in our opinion, are misnamed. No. 1 (18) is absolutely tripinnate, *i.e.*, thrice divided, and constitutes the nearest approach to the plumose state of the species. It is tolerably robust, and forms a large plant, rarely, if ever, fertile, though somewhat contracted and longer fronds are thrown up. They soon, however, assume a leafier character, and join their barren and pendent fellows. No. 2 (15) is very handsome, but is not nearly so much divided; this bears really fertile fronds, and when well grown has a striking likeness to the Holly Fern (*Polystichum Lonchitis*).

B. S. sub-plumosum (somewhat feathery), Phillips (16). A very fine leafy form, but hardly plumose.

B. S. trinervium coronans (three-nerved, crowned), Barnes (Plate III., 11, and Fig. 23). Syn. **multifurcatum** (much-forked). The latter is the fitter name. *Trinervium* implies that the two lowest pinnæ are developed more than the rest, which very rarely occurs in this variety, though it does occasionally. The crest is peculiar, consisting of numerous stiff, radiating points (many-forked); hence the latter name describes it. Wild find, very distinct and beautiful.

B. S. trinervium, Phillips. Two basal lobes developed into small fronds. An inconstant form, but worthy of mention, as it exists in large numbers in the exposed pastures on the Mourne Mountains in Ireland. Under culture we find it loses its character. Mr. G. B. Wollaston found a similar form in Kent.

B. S. trinervium, Hodgson (5). In this the name is right enough, every frond being, as it were, triple, the two bottom pinnæ being developed into veritable fronds, and sometimes duplicated in addition. Very remarkable wild find.

CHAPTER VIII.

THE ADDERSTONGUE FERN

(*Ophioglossum vulgatum*).

THE MOONWORT

(*Botrychium Lunaria*).

NEITHER of these Ferns, in its normal form, can be regarded as ornamental; and as they have yielded no varieties which can aspire to such distinction, we mention them as briefly as possible. The Adderstongue is well named, the whole plant consisting merely of a single frond with two divisions, the main one of which is barren, and shaped very like a small plantain leaf (see Fig. 24), from the lower part of which springs a fertile, contracted spike, not unlike an adder's tongue (whence the name), but resembling equally the plantain seed-spike in its early stage; this, on closer scrutiny, will be found to consist of two rows of closely-set, roundish capsules, containing the spores. The plant grows in myriads in some grass lands, but owing to its small size and insignificant appearance may be easily overlooked.

The Moonwort is a shade more ambitious in its pretensions to beauty. Like the other, its fronds are solitary, but composed of two portions, barren and fertile. The barren ones, however, are once divided into rounded or moon-shaped pinnæ—whence the name—while the fertile spikes are twice divided, each pinna bearing some eight to ten pinnules, composed of clustered spore-capsules only. Habitat, pasture land, like the other.

Both these Ferns resent removal from their native haunts, and require shifting intact, with a good clump of soil, to afford any chance of successful cultivation.

FIG. 24.—THE ADDERSTONGUE FERN (*Ophioglossum vulgatum*), natural size.

CHAPTER IX.

THE BLADDER FERNS

(*Cystopteris*).

CYSTOPTERIS signifies, literally, Bladder Fern, the indusium or spore-cover of this family resembling a bladder or cap—a peculiarity so marked as to render recognition of fertile plants very easy. The spore-heaps are round, and scattered freely over the backs of the fronds. There are several species indigenous to Great Britain, the commonest being *C. fragilis*; the others are rare. All are deciduous, with one doubtful exception, hereafter mentioned. Their roots are more or less creeping, and, their size being small, they speedily, under favourable conditions, make very pretty patches, subject, however, to the drawback that the fronds are very apt to turn brown as soon as they attain full size under cultivation.

The Brittle Bladder Fern

(*Cystopteris fragilis*).

As its name implies, this Fern is of very delicate texture; the fronds are twice divided, roughly spear-shaped, and about 6in. high. It is found growing in chinks in walls and rocks, and under cultivation demands the same treatment as its companions. It needs, however, more protection from the sun, which turns it speedily brown, and from wind, which breaks its tender fronds. It is not so impatient of moisture or close treatment as wall Ferns generally, and hence is not

difficult to grow. It has sported very little, but what it has done it has done well.

C. f. Dickieana (Dickie's). Found wild in Scotland; is a great improvement on the normal form, the fronds being leafier throughout, and the divisions compact, while in the common form they are far apart.

C. f. Dick. crispa (crisped). A curled and congested form of the preceding, the divisions being overlapped and twisted. Very pretty and distinct.

C. sempervirens (evergreen) is believed to be a variety of *C. fragilis*. It is a much bolder growing form, of normal outline, which, if protected during the winter, is reputed to be evergreen, though our experience does not confirm this. It has given, we believe, the only constantly crested form of the species, viz.,

C. cristata (crested), in which all the fronds are crested, but in a varying degree, some very heavily and handsomely, and some on a small scale only.

The Mountain Bladder Fern

(*Cystopteris montana*).

THIS is not very dissimilar to the Oak Fern (*Polypodium Dryopteris*) in the plan of its fronds and general habit of growth, but lacks the peculiarly lovely green of that Fern. It is reputed to be very difficult of cultivation, but we have grown it for years in ordinary open Fern soil, well drained; and having transferred small portions at random into pots with other Ferns, have found them thrive under quite general conditions. It starts into growth very suddenly in the early spring, and dies down in the early autumn. It is very pretty, but has afforded, so far, no varieties.

Alpine Bladder Fern

(*Cystopteris regia*. SYN. *C. alpina*).

THIS is extinct now as a wild plant. It resembles strongly *C. fragilis*, and has not sported. Cultivation same as other members of the family.

CHAPTER X.

THE SMALL-LEAVED GYMNOGRAM

(*Gymnogramma leptophylla*).

UNLIKE its botanical name, this Fern is dwarf and pretty. Though a British representative of a large genus, it has never got farther than Jersey in a wild state. It is also peculiar in being one of the very few annual Ferns in the world; hence it has continually to be raised anew from the spores, and practically can only be kept in such congenial situations that it can sow itself. When once established in a moist, shady house, not too cold in winter, its spores will germinate freely and keep up a supply. In structure it is not unlike a small plant of *Cystopteris fragilis*, with the pinnules somewhat blunter. The spore-heaps are long and forked, and run all together when ripe. The plant dies down in July, and the seedlings appear in November.

PLATE IV. VARIETIES OF THE BUCKLER FERN

PLATE IV.

Varieties of the Buckler Fern

(*Lastrea.* Syn. *Nephrodium*).

Fig.		
1.	*Lastrea dilatata grandiceps*, Barnes.	
10.	„ „	*cristata gracilis* (tip of frond).
15.	„ „	*folioso-cristata* (top half of frond).
2.	„ *pseudo-mas ramosissima.*	
4.	„ „	*ramulosissima.*
5.	„ „	*cristata* (pinna).
7.	„ „	*crispa cristata.*
8.	„ „	*revolvens* (centre of frond).
11.	„ „	*polydactyla*, Dadds (tip of frond and pinna).
14.	„ „	*ramo-cristata*, Fitt.
16.	„ „	*crispa cristata angustata.*
3.	„ *filix-mas grandiceps*, Berry.	
6.	„ „	*Bollandiæ* (pinna).
13.	„ *propinqua cristata* (tip of frond).	
9.	„ *æmula* (*recurva*) *cristata* (seedling frond).	
12.	„ *montana cristata*, Barnes (top half of frond).	

CHAPTER XI.

THE BUCKLER FERNS

(*Lastrea.* Syn. *Nephrodium*).

WE now come to the robuster genus of the Buckler Ferns, or Lastreas, the majority of which, though often found as seedlings in any chinks which will afford roothold and shelter, are thorough ground Ferns, attaining their greatest development in plantations, hedgerows, and so on. A general compost of good loam and leaf mould or peat, in equal parts, with a little sand to keep it open, will suit them all. This in most cases will be found to be Dame Nature's own mixture where they grow most luxuriantly. They derive their name of Buckler Ferns from the shape of the little covers over the spore-heaps; the distinction, however, in this respect between the Buckler Ferns and the allied family of the Shield Ferns is, like the distinction between the names, too fine drawn to be popularly appreciable. The Buckler Fern spore-covers are, however, kidney shaped, and attached to the frond by a short stalk springing from the notch, while in the Shield Ferns they are quite round and attached, mushroom fashion, by a central stalk. It will be seen by this that, apart from the other characters of the two families, the notch in the spore-cover, or its absence, is the distinctive mark of the fructification.

We will now describe the various species seriatim. The figures in parentheses refer to Plate IV.

The Hay-scented Buckler Fern

(*Lastrea æmula.* SYN. *L. recurva*).

THIS Fern grows somewhat waywardly in many parts of the country, *i.e.*, it may be vainly sought for in likely districts for miles, and suddenly be found in abundance. It grows in tufts, the fronds ranging from 1ft. to 2ft. in height, of a somewhat triangular form, the pinnules concave (hence its second name), which gives it a very peculiar and pretty character, while the fronds possess a strong hay-like perfume, quite powerful enough to settle any doubts as to the species. It likes an open soil, and is not difficult to cultivate. Though by no means rare, it has so far yielded only one fine variety, viz.,

L. æ. cristata (crested) (9). This was found some years ago in North Devon, and is a perfect example of symmetrical cresting, both fronds and pinnæ tips being furnished with delicate-looking, flat tassels. It bears spores in profusion, and these we have found to yield remarkably constant offspring, all the plants, without exception, exactly resembling the parent. As it is an evergreen, it forms a most ornamental pot Fern.

The Broad Buckler Fern

(*Lastrea dilatata*).

THIS Fern is a much robuster grower than the last, to which it is closely allied. It forms, under favourable conditions, huge, spreading plants, waist, and even shoulder, high. It is by no means difficult to cultivate, growing in almost any kind of soil, but in winter it disappears, being deciduous. Its fronds are very broadly triangular, whence the name; they are thrice divided, and the stalks profusely covered with dark brown scales. *Lastrea spinulosa* and *L. cristata* are very closely allied to this species, with which we therefore class them, as to define precisely their characteristic differences would involve technicalities beyond our present scope.

L. dilatata has afforded numerous very distinct and beautiful varieties.

L. d. alpina plumosa (alpine, feathery). A very beautiful plumose form, of normal outline, recently found on Ben Nevis.

L. d. crispata cristata (crisped, crested). A very fine form, with wide, branchy heads; large grower, sometimes 2½ft. high, with crests 1ft. in diameter.

L. d. cristata gracilis (crested, slender) (10). A very beautiful, slender-growing, crested form; fronds and pinnæ flatly tasselled, unfortunately with a tendency to irregularity, but not to reversion.

L. d. folioso-cristata (leafy, crested) (15). This is a magnificently crested form; fronds and pinnæ heavily and symmetrically bunch tasselled; all the divisions are, moreover, very leafy, and slightly convex, giving a very rich appearance. This Fern is occasionally proliferous, bearing young plants on the frond-stalks, near the bottom. This variety was found in the Azores; so was

L. d. folioso-digitata (leafy, digitate). A kindred but distinct form, not quite so leafy, and with flat, spreading crests instead of leafy ones. These two forms, and some crested exotic Ferns, *Woodwardia radicans* to wit, were found in the Azores by the same botanist, and form a strong argument in favour of our contention that crested varieties of most exotics exist, and only need special search to be found.

L. d. grandiceps (large-crested), Barnes (1). A wild find, and the most heavily crested of all, the crests being ball-shaped, and very dense. Very handsome and constant.

L. d. Howardii (Howard's). Wild find, and too curious a sport to be omitted, the pinnæ being almost exact copies, on a smaller scale, of the fronds of *Athyrium Filix-fœmina Fieldiæ, i.e.*, the pinnules are transformed into short, radiating clusters.

L. d. lepidota (scaly). A non-crested but very finely divided form; fronds divided four times. Well worth a place in a choice collection.

L. d. polydactyla (many-fingered). Flat, many-fingered crests.

THE COMMON BUCKLER OR MALE FERNS

(*Lastrea Filix-mas, L. pseudo-mas,* and *L. propinqua.* Syn. *Nephrodium*).

The common Male Fern, in one or other of its three divisions, is very generally distributed, and will grow in any soil. Special cultural remarks are therefore needless. The term Male Fern (*L. Filix-mas*) was formerly applied to the entire species, but Mr. G. B. Wollaston, with the general approval of both botanists and amateurs, has divided the species into three sub-species, possessing each quite distinct characters. We give them in the order of their merit as ornamental plants, as follows. The figures in parentheses refer to Plate IV.

The Hard Male Fern

(*Lastrea pseudo-mas*).

Special characters: Fronds and pinnæ flat; pinnules smooth-edged, or very slightly toothed; colour bright yellowish-green when young, deep and shining green later; stalks clothed with golden brown scales; texture leathery. Quite evergreen when sheltered; forms a trunk under favourable circumstances. The evergreen character of this section places it decidedly in the first rank, the plants retaining their ornamental appearance well through the winter, while the other sections, being deciduous, are conspicuous by their absence. In the spring, as soon as the new fronds begin to rise, the swelling of the crowns throws the old ones outwards, and while they are yet green and healthy, a weak point is developed near the base, and a sudden fall results, when they can be removed. This has afforded us, among other fine varieties,

L. p.-m. cristata (crested) (5), a wild find, which in its bold and striking habit of growth, and symmetrical and constant cresting of fronds and pinnæ, takes deservedly rank as the King of our British Ferns. If left untouched, buds which exist near the bases of the fronds are very apt to assert themselves and turn the plant into a bush consisting of many comparatively small plants. If, however, all the side shoots

be constantly suppressed, the single crown will not only produce fronds of a much bolder character and greater beauty, but, in time, a trunk is formed, each year's growth springing slightly above that of the previous year, the result eventually being a magnificently tasselled Tree Fern, well deserving, in this guise, the royal title bestowed upon it. The spores of this Fern germinate freely, and hence, fine as the plant is, it ranks among the easiest to procure, though it is rarely done justice to in the way indicated above. It is produced from the spores apogamously (technical, but we can't help it this time), *i.e.*, by simple buds forming under the prothallus, instead of through the usual generative process. Its offspring are remarkably constant, but not invariably so, as it has yielded

L. p.-m. crist. angustata (crested, narrow), a less robust form, with very much narrower fronds, in which all the pinnæ are joined together. As the fronds are very long, and only 2in. to 2½in. wide, it is peculiarly distinct and striking.

L. p.-m. crispa (crisped). A remarkably pretty, dwarf, and densely compressed form, growing 6in. to 9in. high only.

L. p.-m. crispa cristata (crested) (7). The same, neatly crested at all tips.

L. p.-m. crispa cristata angustata (narrow) (16). Precisely the same sport as *L. p.-m. cristata angustata*, occurring in conjunction with the dwarfed and crispy variation. A singular example of several types of variation conjoined.

L. p.-m. crispa gracilis (slender). In this we have the crisped character modified in a very singular way, the pinnules being bent back and the pinnæ curved forward and sharply pointed. Most remarkable sport.

L. p.-m. polydactyla (many-fingered), Wills. A splendid flat-crested form, running *L. p.-m. cristata* very close for first place, as does also

L. p.-m. polydactyla, Mapplebeck, as fine a form, with branchy crests.

L. p.-m. polydactyla, Dadds (11). This has somewhat thinner fronds than usual, with flat, spreading crests at frond tips and pinnæ; elegant and distinct.

L. p.-m. ramo-cristata (crested-branched), Fitt (14). Fronds branch several times, beginning at the base; divisions crested neatly; forms consequently a compact bush of very ornamental character.

L. p.-m. ramosissima (much-branched) (2). The fronds of this splendid variety branch also repeatedly, but as it has longer stalks, and the crests are branched and heavy, it acquires the appearance rather of a round-headed tree, and is deservedly considered one of the handsomest variations of the species. It appears to be very doubtfully fertile, the spores appearing either to stop short of full development, or, as some growers believe, to produce inferior forms. Hence it is very rare, being propagated only by division.

L. p.-m. ramulosissima (much-branched) (4). A very dwarf form, only 1in. or 2in. high, and a dense mass of cresting. This was raised from a spore of

L. p.-m. Schofieldii (Schofield's), an equally dwarf variety with merely forked fronds.

L. p.-m. revolvens (turning over) (8). A lovely form, with peculiarly neat, smooth-edged pinnules, and the pinnæ curled backwards semi-circularly, forming the fronds in graceful, arching tubes.

The Soft Male Fern

(*Lastrea Filix-mas*).

Fronds and pinnæ convex; pinnules saw-toothed, or doubly so; colour shiny pale green; texture papery. Deciduous.

This section, not being evergreen, loses in comparison with the previous one, so far as winter decoration is concerned. It has not been so prolific in varieties, but what exist include some good ones.

L. F.-m. Barnesii (Barnes'). Wild find. A very neat, uncrested form, with narrow fronds, the pinnæ being shorter and compacter than the normal.

L. F.-m. Bollandiæ (Bolland's) (6). The nearest approach to the plumose form yet found in this family. When grown under glass, it fully justifies the term of plumose, all the divisions being very beautifully and delicately developed. Out

of doors a crispy character is assumed, which detracts from its beauty, nor does it acquire the same delicacy.

L. F.-m. cristata (crested), Martindale. A neatly crested form, with pinnæ curved upwards towards tip of frond, giving a very distinct character.

L. F.-m. fluctuosa (fluctuating). Fronds much congested, and also pinnæ; pinnules curly. Remarkably distinct.

L. F.-m. grandiceps (large-crested), Sim. A grand, heavily-crested form, with branching fronds. Very fine indeed.

L. F.-m. grandiceps, Berry (3). A really magnificent branched and crested form, found in North Devon, all the pinnæ bearing very finely cut tassels of many divisions.

L. F.-m. grandiceps, Wills. Also a handsomely crested form, but tassels less finely cut.

L. F.-m. linearis (linear). Very distinct. Pinnæ extremely narrow, and pinnules consisting of mere sharp points.

The Intermediate Male Fern

(*Lastrea propinqua*).

Fronds and pinnæ concave; pinnules doubly saw-toothed; colour dull pale green. Deciduous; texture soft.

This is the rarest by far of the three sections, also the smallest in size. Varieties few.

L. p. cristata (crested), Barnes (13). Pinnæ neatly crested; frond tip densely. Wild find.

L. p. crispata incisa (crisped, cut), Smithies. Pinnules very finely cut and somewhat curly. Distinct and pretty.

L. p. grandiceps, Barnes. Heavily crested.

The Mountain Buckler Fern, or Lemon-scented Fern

(*Lastrea montana* [*oreopteris*]. Syn. *Nephrodium montanum*).

This is a very beautiful Fern, which by beginners is frequently taken for the Male Fern, but on better acquaintance never, since it differs most unmistakably in the fact that the pinnæ commence very short close to the base of the frond, gradually widening towards the centre, and tapering again similarly,

though rather more abruptly, towards the top, while the Male Ferns, on the other hand, have a bare stalk for some distance, and the leafy part begins abruptly with long pinnæ.

The unfolding tips of *L. montana* resemble a ball bristling with recurved points, resembling in this respect exactly the Marsh Fern (*L. Thelypteris*), while the Male Fern fronds at same stage resemble shepherds' crooks, the pinnæ being rolled inwards. Finally, should any doubt still exist, an undeniable scent of lemon is perceptible if the fronds are passed through the hand. This scent is peculiar to the species, and gives it one of its popular names.

This Fern is daintier in its requirements than the Male Fern, and is therefore neither so widely distributed nor so easy to grow. It demands plenty of moisture, but stagnancy is fatal; a good loamy soil suits it admirably if well drained. It is not very sportive, and for a long time defied the searchers for varieties; but at length, like most of its relations, it rewarded perseverance, and yielded some very good and distinct forms.

L. m. Barnesii (Barnes') stands alone among all Ferns found as yet, in the fact that the pinnæ on the long, narrow fronds are set at right angles to the stalk, and across the frond, so that when it is laid down flat, the pinnæ stand on their edges.

L. m. congesta (crowded). A dense form, with very closely set divisions.

L. m. coronans (crowned), Barnes. This is a very heavily coronet-crested form, for which we are indebted to Mr. J. M. Barnes, of Levens, who has been most successful in his wooing of this very coy species.

L. m. cristata (crested), Barnes (12). A very finely crested variety, due to same source.

L. m. grandiceps (large-crested), Smithies. Wild find, very heavily crested. Mr. Barnes has raised a similar or even better form from spores of a crested find of his.

L. m. Nowelliana (Nowell's). Very singular wild sport. Pinnæ narrow and sharply pointed; pinnules irregular, short, and sharply saw-toothed. Scarcely beautiful, but too curious to omit.

L. m. plumosa (feathery), Airey. Fine plumose form, with general aspect of a Lady Fern.

L. m. ramo-coronans (branched-crowned). Crested like *coronans*, but the fronds branch previously, thus multiplying the crests.

The Rigid Buckler Fern

(*Lastrea rigida.* SYN. *Nephrodium rigidum*).

A TYPE of *Lastrea* of very limited distribution, being found growing only in clefts of limestone rocks, notwithstanding which, however, it is grown without difficulty in ordinary soil. It is deciduous, and differs from the Male Fern in its stiffer growth, smaller size, and dusty, dull green colour. No constant varieties have been found, and it is not in itself attractive.

The Marsh Buckler Fern

(*Lastrea Thelypteris.* SYN. *Nephrodium Thelypteris*).

THIS is one of the few Ferns which delight in absolute mud, a fact which must not be forgotten in its cultivation. In appearance its fronds nearest resemble *L. montana*, their mode of unfolding being identical. The fronds, however, have long stalks, and the narrow, tapering, basal pinnæ are lacking; the frond, minus the long stalk, approaching closely the shape of the Male Fern. The most characteristic difference, however, is that the fronds rise singly from a slender, creeping root-stock, instead of in a clump from a crown, so that under favourable conditions the Fern spreads in all directions, and the shuttlecock plan of architecture assumed by all the rest of the British Lastreas is totally abandoned.

To cultivate this Fern the best plan is to sink a *glazed* earthenware pan quite below the surface of the soil, fill this half full of bits of brick and sphagnum moss, shovel in the common soil, and plant the Fern. The pan, by holding a supply of water, will form a capital starting point, whence the Fern will ramble, unless checked, in all directions, driving its roots a yard or more into otherwise uncongenial soil. No varieties.

CHAPTER XII.

THE ROYAL FERN

(*Osmunda regalis*).

A WELL-NAMED Fern is this, as everyone will allow who has seen it at its best, clothing the banks of our Devonshire streams with a dense shrub-like growth, in which a tall man might stand unseen, the fronds attaining sometimes a length of 12ft. Plenty of moisture is imperatively necessary for the well-being of this Fern, which, under natural conditions, has its roots constantly wet or exposed to a moist atmosphere. The moist atmosphere is rendered requisite by the fact that a large portion of the root is formed on the surface of the ground in the shape of huge, rounded masses, sometimes several feet over, covered with absorbent root-points—aërial roots, in fact—from among which here, there, and yonder spring the crowns of towering fronds. These fronds, though of tough, leathery texture, are perfectly deciduous, renewing their growth in the spring with great rapidity.

Apart from its huge size, the Royal Fern is easily distinguished by the terminal pinnæ and tip of frond being contracted and transformed into long, narrow masses of brownish spore-capsules, distantly resembling a flower of the *Spiræa* type, whence it is sometimes, though of course

erroneously, termed the Flowering Fern. The ultimate divisions are very large, and shaped like a short scythe. To those desirous of trying to raise this Fern from its spores, which is not difficult, it may be well to mention that they are shed while the capsules are still of a green colour; the ripe spores themselves are also of an olive-green colour, instead of the usual dark brown tint. Thus, when the capsules assume a brown tint, it is too late, and a microscope will display a profusion of husks and a plentiful lack of spores. Only two good varieties of this Fern have been found.

O. r. cristata (crested). This was a wild find, but being gathered in the winter by accident, in company with a batch of common ones, it formed an agreeable surprise to the purchaser when it displayed its peculiar beauties in the following spring. It is a charmingly-crested form, all the divisions being flatly expanded and crested in a manner which, while detracting in no way from the normally bold character of the Fern, by the weight of the tassels causes it to assume an additional graceful habit of growth, rendering it decidedly one of the most desirable forms existing.

O. r. ramo-cristata (branched-crested). A crested type, similar to above, but the fronds split up before cresting. We are indebted for our knowledge of this form to Col. A. M. Jones' splendid Nature Prints of our British Ferns.

PLATE V. VARIETIES OF THE COMMON POLYPODY

PLATE V.

Varieties of the Common Polypody

(*Polypodium vulgare*).

Fig.

1. *Polypodium vulgare* (normal form).
2. ,, ,, *bifido-cristatum.*
3. ,, ,, *ramosum,* Hillman.
4. ,, ,, *cristatum,* Scarborough.
5. ,, ,, *cristatum* (old form).
6. ,, ,, *multifido-cristatum* (*grandiceps,* Parker).
7. ,, ,, *grandiceps,* Fox.
8. ,, ,, *pulcherrimum.*
9. ,, ,, *cambricum* (*plumosum*).
10. ,, ,, *cornubiense* (*elegantissimum*).
11. ,, ,, *parvissimum.*
12. ,, ,, cross between Nos. 2 and 10.
13. ,, ,, *omnilacerum.*

CHAPTER XIII.

THE POLYPODIES

(*Polypodium*).

E now come to a family of which the members vary exceedingly in everything but the form of fructification, which consists of round masses of spore-capsules without any cover (*indusium*). The term Polypody, meaning many-footed, refers to the creeping rootstock, which feature is, however, by no means peculiar to this family, as will have already been seen by the preceding descriptions. On the other hand, some of the Polypodies (the so-called *P. alpestre*, for instance) are not many-footed at all, being built *à la* shuttlecock. These little anomalies are, however, unavoidable in any method of classification, seeing that Dame Nature indulges her own whims and fancies with a sublime disregard of the hard and fast lines which scientists, with the best intentions, are always endeavouring to draw amongst her creations. The species included in the *Polypodium* family all over the world are very numerous; we have, however, only four indigenous to Great Britain, exclusive of *P. alpestre*, which belies its name in all respects but its uncovered spore-heaps. These botanically cannot be got over, though we have ventured to class it with the Lady Ferns on account of its great affinity with them in all other respects.

The Oak Fern

(*Polypodium Dryopteris*).

THIS charming little Fern, the fronds of which are thrice divided on the plan of an ivy leaf in general outline, is distinguished from all others by its peculiarly delicate pale green colour, which renders a well-grown clump one of the most refreshing and delightful specimens of vegetable life which the eye could desire to rest upon. The fronds stand generally

FIG. 25.—POLYPODIUM DRYOPTERIS.

about 6in. to 7in. high, but are an inch or two longer, the tall, slender, green stalks bending back at an abrupt angle, just where the leafy portion commences, so that the latter lies nearly horizontally. This bend is another distinctive mark, and is useful in discriminating it from the Limestone Polypody next described, and which otherwise closely resembles it, though lacking the special tint of green. The young fronds also, when unfolding, exactly resemble the pawnbroker's sign

of three balls, which those of the Limestone Polypody do not do.

The Oak Fern makes itself at home in any open, well-drained compost, its slender, creeping rootstalk, branching in all directions just below the surface, and speedily taking possession of the pot, or, better still, shallow pan, in which it is located. On rockwork it soon establishes itself in the chinks and crevices, and though, as if being fully satisfied with itself, it has disdained to present us with any variations, every collection worthy the name must find a place for it. It is perfectly deciduous, and needs shelter from wind to display its graces fairly.

The Limestone Polypody

(*Polypodium calcareum.* Syn. *P. Robertianum*).

This differs from the preceding very little, and the points of dissimilarity have already been indicated. As its name implies, it grows in the chinks and cracks of calcareous rocks, and hence in cultivation requires some admixture of lime in the soil. In all other respects, the remarks on the Oak Fern apply to this. No varieties.

The Beech Fern

(*Polypodium Phegopteris*).

Why this Fern is so named we cannot conjecture, and should like to know. It frequents similar habitats to the Oak Fern, and runs about in a precisely similar manner; the same method of cultivation consequently applies. This Fern approaches the *Lastrea* type in the form of its fronds (which, however, have a longer stalk), and may infallibly be known by the peculiarity that the two lower pinnæ, which are long, are turned sharply downwards at an angle of about 45deg., while all the rest are about at right angles to the central stalk. The colour is a very delicate green, somewhat akin to that of the Oak Fern. The twice-divided fronds are 6in. to 9in. long, prettily pendent on the long stalks. Of this Fern we have one variety,

P. p. multifidum (much-cleft), a wild find, with pinnæ and frond tips flatly but somewhat irregularly crested.

The Common Polypody

(*Polypodium vulgare*).

THIS Fern is one of the most generally distributed, and differs in many respects from the other members of the family already described. First and foremost, unlike the others, it is a thorough evergreen, retaining its verdure quite

FIG. 26.—POLYPODIUM VULGARE, showing Habit and Under Surface of Portion of Detached Frond.

fresh right through the winter. The fronds are sometimes 18in. in length, but only once divided, the pinnæ being normally smooth-edged, and broadening out at their bases, so that they generally join, and form a continuous, narrow wing on each side of the central stalk (*vide* Plate V., 1). The creeping rootstock is fleshy, and as thick as the little finger, while the fronds are comparatively leathery, and of a dark green colour, bearing on their backs the large, golden-yellow heaps of spores, which form most conspicuous and beautiful examples

of the fructification peculiar in the *Polypodium* family. The Fern by its tough nature is enabled to stand plenty of air, and even of sunshine, and we consequently find it at home on the tops and in the crevices of old walls, on the roofs of old buildings, and cosily nestling amongst moss-grown rocks, and similar places where its roots can creep freely about in accumulations of leaf mould. We also find it clothing the sloping sides of hedge banks, and forming a dense undergrowth among the roots of the hedges themselves; and lastly, but by no means leastly, it makes itself a congenial home in the mossy bark of old trees, and amongst the *débris* which collects in their forks and other hollows. Good drainage and plenty of leaf mould are, it will be seen, the first desiderata of its cultivation. As the creeping rootstocks do not burrow, but keep near, or even on, the surface, this fact must be remembered in planting. This Fern, simple as it is in its normal outline, has given us some most beautifully divided, crested, and plumose varieties (*vide* Plate V., to which the figures in parentheses refer).

P. v. bifido-cristatum (twice-cleft, crested) (2). A long, narrow, robust, crested form, the short pinnæ fanned out at tips into rounded crests, the frond tip repeatedly divided, forming a large, flat tassel.

P. v. cambricum (Welsh) (9). This, which is commonly called the Welsh Polypody, is the true plumose form of the species, and is always barren. It has been found wild in various places. In this, the ordinarily simple pinnæ are so wide as to overlap considerably; they are also divided into long, saw-toothed divisions. The texture of the fronds is much thinner and more delicate than in the normal form, and the width considerably greater. A most beautiful form indeed.

P. v. camb. Prestonii (Preston's). A still more plumose form than the last. Wild find. Lake district.

P. v. cornubiense (Cornwall), SYN. **elegantissimum** (most elegant) (10); **P. v. Fowlerii** (Fowler's); and **P. v. trichomanoides** (Trichomanes-like) (*vide* Fig. 27). These three are too closely akin to be separately described; they stand in order of

merit. The fronds are of three classes, viz., a few absolutely normal; others with the pinnæ sub-divided into long, blunt-pointed segments; and, finally, exquisitely divided fronds of the most delicate character. In *trichomanoides* the intermediate fronds do not appear. A curious feature of all three is the occasional appearance of mixed fronds, in which quite common plain pinnæ are mixed up anyhow with others of the most divided type. The first-named is the parent of the other two.

FIG. 27.—POLYPODIUM VULGARE TRICHOMANOIDES.

P. v. cristatum (crested) (5). Old wild find. Frond and pinnæ tips uniformly and neatly flatly crested.

P. v. cristatum, Scarborough (Woll) (4). A very superior form, with cresting much more developed.

P. v. cristatum, Forster. One of the grandest crested forms found in Lake district. Crests at all tips. Very large.

P. v. Claphamii (?) (Clapham's) (12). Provisionally named. This is one of the most striking, and at the same time most beautiful, examples of hybridisation, it being an unmistakable cross between *P. v. bifido-cristatum* (2) and *cornubiense* (10).

The characters of both the parents are distinctly conjoined, the result being a slightly expanded form of *cornubiense*, crested at all tips à la *bifido-cristatum*. The piecemeal reversion peculiar to the former is maintained, but the usually normal parts take the character of the latter, so that the joint parentage, it will be seen, is demonstrated beyond the shadow of a doubt.

P. v. glomeratum (clustered), Mullins. This is an oddity, every frond and division branching repeatedly anyhow, no two alike.

P. v. grandiceps (large-crested), Fox (7). The finest crested form yet found. Immense, wide, curly crests at all terminals. Extremely handsome.

P. v. multifido-cristatum (much-cleft, crested). Syn. **grandiceps** (Parker) (6). End of frond very much branched, with minute, curly crests at tips of all divisions, forming a huge, bunchy tassel at the expense of the pinnæ, which are comparatively few.

P. v. omnilacerum (wholly torn) (13). One of the finest and robustest forms known, when it can be got to develop properly; pinnæ divided into very long, toothed divisions, overlapping densely.

P. v. parvissimum (very small) (11). Introduced into our plate to exemplify range of size, its neighbour there (13) attaining 24in., while this, which has been found several times, is a miniature reproduction of the common, under 1in. when full grown.

P. v. pulcherrimum (very beautiful) (8). A beautifully-divided form, resembling *cambricum* in general outline, but without its delicacy of texture, the fronds being of the normal leathery character, and freely fertile; the ultimate divisions are also not so finely saw-toothed. Wild find.

P. v. plumosum (feathery), Hadwin. Another very fine plumose form, and sufficiently distinct.

P. v. ramosum (branched), Hillman (3). A robust form, in which the fronds all branch from below upwards repeatedly, forming frequently wide, flat crests, when the forking is carried far enough.

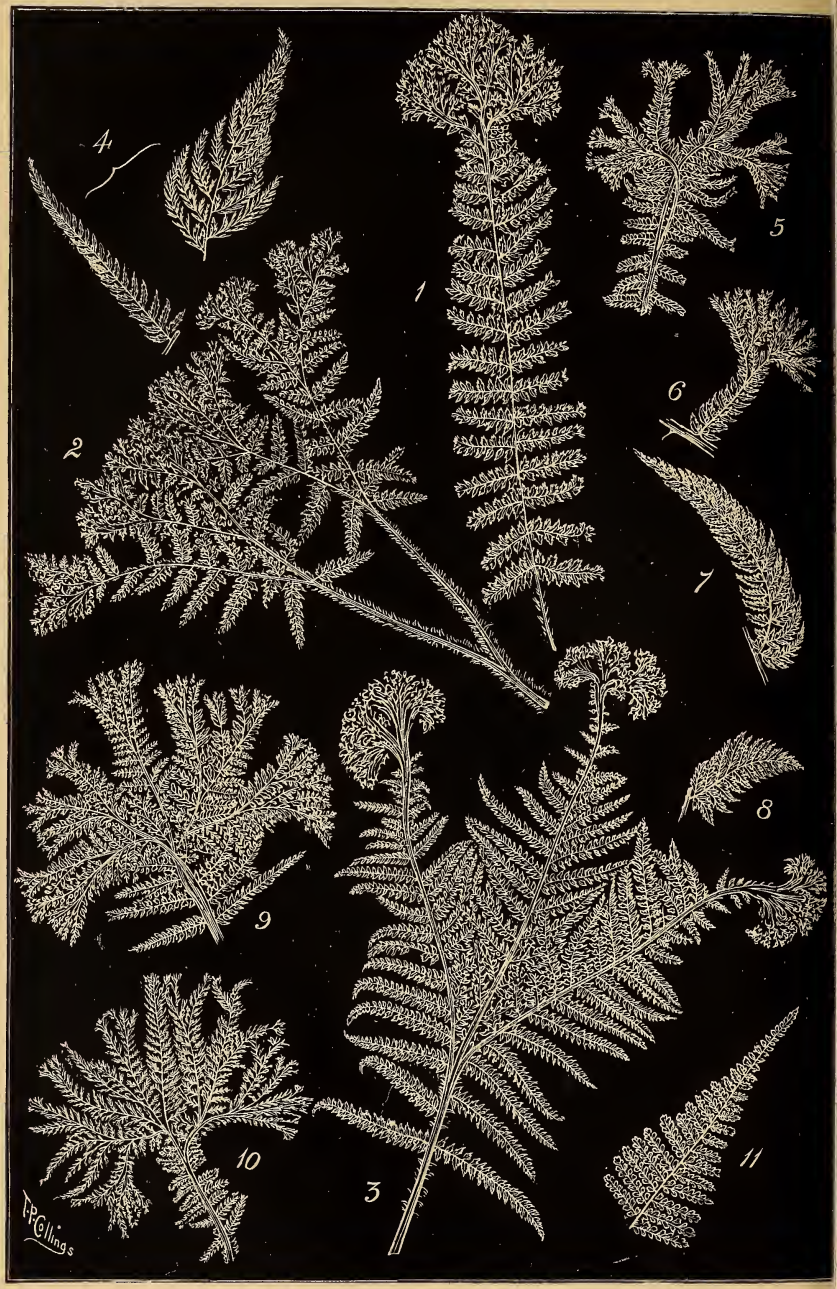

PLATE VI. VARIETIES OF THE SHIELD FERN.

PLATE VI.

Varieties of the Shield Fern

(*Polystichum.* Syn. *Aspidium*).

Fig.

1. *Polystichum aculeatum acrocladon.*
4. „ „ *pulcherrimum* (pinna and tip of frond).
2. „ *angulare acrocladon.*
3. „ „ *brachiato-cristatum*, Gray.
5. „ „ *Thompsoniæ* (top half of frond).
6. „ „ *divisilobum cristatum*, Ivery (pinna).
7. „ „ *pulcherrimum variegatum*, Moly (pinna).
8. „ „ *Pateyii* (pinna).
9. „ „ *cristatum*, Wollaston (crest).
10. „ „ *grandiceps*, Talbot (crests).
11. „ „ *rotundatum* (top half of frond).

CHAPTER XIV.

THE SHIELD FERNS

(*Polystichum.* Syn. *Aspidium*).

ROBUST beauty combined with delicacy of detail are the characteristics of this family, which is represented in Britain by three species, and is easily distinguished from others by the spiny character of the subdivisions, and by the covers of the spore-heaps, which are flatly mushroom shaped, being circular, and attached to the frond by tiny central stalks—the Buckler Ferns, it will be remembered, having a notch in the cover, which renders them kidney-shaped. Besides these characters, the rising fronds of the Shield Ferns, in unfolding, turn inside out, the last few inches hanging downwards at the back of the frond—a feature quite peculiar to this family, so far as Britain is concerned. The young fronds are also densely clothed with silvery-white scales when they first lift from the crown, which scales turn brown as the fronds mature. Two out of the three species are pretty generally distributed; the third, the Holly Fern (*P. Lonchitis*) must be sought for high up in the mountains—it is never found below a certain level. They are all thorough evergreens, and on that account, coupled with their charming diversity of form, hold first rank as ornamental Ferns. Soil, rich, strong, fibrous loam, with plenty of root room.

The Holly Fern

(*Polystichum Lonchitis*).

This is a true mountain Fern, and is never found wild, except at very high elevations. It is easily recognised as a *Polystichum* by its spiny pinnæ, but its distinctive characteristic is that these are quite undivided, the edges of the pinnæ being merely scalloped and prickly, like small holly leaves, whence its name. It is a thorough evergreen, and a rock Fern; hence it demands good drainage, plenty of moisture, and a humid atmosphere, its natural home being in or near the clouds. Should the beginner number this Fern, as he probably will, amongst his finds in some lowland lane, he will be wise to anticipate experience, and call it *P. aculeatum*; he will then have the advantage over more obstinate *confrères* of being correct from the beginning. It has been very chary of varieties so far—possibly, we think, on account of its comparative inaccessibility—having only recently presented us with its first decided sport, viz.,

P. L. cristatum (crested). A good crested form, found on Ben Qui by Dr. Craig.

The Hard Prickly Shield Fern

(*Polystichum aculeatum*).

This bold-growing, handsome, evergreen Fern is very generally distributed, but by no means so lavishly as its very close relation the Soft Prickly Shield Fern (*P. angulare*), from which it can be discriminated, as its common name indicates, by its harder texture, and also the more prickly nature of its pinnæ. In its young state it frequently confers considerable temporary gratification upon novices, who, misled by its appearance, record the discovery of the Holly Fern (*P. Lonchitis*) in many localities where it does not exist. For the benefit of such, it should be noted that in *P. Lonchitis* the pinnæ are never divided, while in *P. aculeatum*, even in a young state, the basal pinnæ at any rate will be found more or less split.

It is found growing in its greatest luxuriance on the sloping sides of glens and deep ravines, in such situations forming

huge, circular plumes, with radiating, pendent fronds between 2ft. and 3ft. in length. It is not difficult to cultivate in ordinary compost, and, when well established, becomes, from its evergreen character and habit of growing from one crown only, one of the boldest and most ornamental of all the normal forms. It has sported into some very handsome varieties. The figures in parentheses refer to Plate VI.

P. ac. acrocladon (summit-branched) (1). Beautifully and symmetrically crested throughout.

P. ac. acutilobum (acutely-lobed), Wills. A distinct form, with sharply-pointed and somewhat lengthened subdivisions.

P. ac. corymbiferum (corymb-bearing). Heavy, tufted crests.

P. ac. cristato-gracile (crested, slender). A slenderer form than the normal, with somewhat pendent, neat crests.

P. ac. pulcherrimum (very beautiful) (4). A remarkably handsome and extremely rare, uncrested form, quite barren, and with the pinnules beautifully elongated and curved, sickle fashion, imparting a peculiar beauty to the frond.

The Soft Prickly Shield Fern

(Polystichum angulare).

This very beautiful Fern is plentifully distributed in most Ferny districts, making itself at home in hedgerows, plantations, and ravines, and affording every here and there the most fascinating hunting grounds for the searcher for varieties. In its normal form it is easily distinguished from the preceding, *P. aculeatum*, the divisions being smaller, and the fronds more delicate in texture and make. In some of its varieties it approaches *P. aculeatum* so closely that the best judges differ in their classification; Nature in this case, as in so many, bridging over the gap between botanical species.

As regards variation, this Fern is one of the most interesting of all our British species, and perhaps the best of all adapted for educating the eye to observe minute yet distinct characteristic differences. In searching carefully a hedgerow peopled with this Fern, it will be the exception if a careful comparison of a collection of fronds will not show a wide

range of difference in the make of the ultimate divisions, or pinnules, and even in the texture and general character of the entire fronds; while so many really extraordinary forms have been found wild that there is always a reasonable expectation of lighting upon something startling. The word startling may seem exaggerated, but becomes appropriate, for instance, when applied to the discovery of such a Fern transformed into a confused mass of very long, narrow fronds, spirally twisted and contorted like so many serpents twining about amongst the undergrowth around it. Yet this precisely describes one of Mr. G. B. Wollaston's finds, which has maintained its character for many years. So much by way of example. Cultivation is easy in good, strong loam, and plenty of root room if in pots.

The capacity of variation in this Fern is so great, and the size of many of its best forms such, that a large space would be required to accommodate a fair selection of those in trade hands, outside of which there are practically innumerable forms, including some of the best, which exist as unique plants in private hands. It is, indeed, so fascinating a Fern that the most noted collectors generally become *Polystichum* fanciers in particular in course of time. It will be seen from this that in making our selection many omissions are inevitable, and only some of the best forms extant, and within our own personal cognizance, can be cited. The figures in parentheses refer to Plate VI.

P. ang. acrocladon (summit-branched) (2). Wild find. This is the counterpart in this species of *Athyrium Filix-fœmina acrocladon*, the fronds being divided low down into branches bearing dense crests. A splendid form.

P. ang. attenuato-cristatum (attenuated, crested), Elworthy. A very delicate, slender form; fronds and pinnæ neatly crested.

P. ang. brachiato-cristatum (branched, crested), Keall. One of the startling series of finds, the two lowest pinnæ being transformed into fronds, forming a sort of trident, with each prong tipped with a dense, ball-like tuft of cresting.

P. ang. brachiato-cristatum, Wills, Gray (3). Two

distinct finds of similar pattern, but hardly in so exaggerated a form.

P. ang. cristatum, Wollaston (9). A beautifully tasselled form; small crests at pinnæ tips, but heavy and finely-divided one at frond tip.

P. ang. cristato-gracile (crested, slender), Gray. A somewhat slender-growing form, with frond tips and pinnæ neatly tasselled.

P. ang. congestum (crowded). A very beautifully congested form; pinnæ and pinnules closely set and overlapping.

P. ang. crispato-foliosum (crisped, leafy). A very distinct and leafier form, with same overlapping character as last.

P. ang. capitatum (headed), Miles. Peculiarly distinct; pinnæ neatly crested, and frond with remarkably broad, flat, spreading crest.

P. ang. cruciatum (crossed), Elworthy. A narrow-fronded form, with double pinnæ, starting at about right angles to each other, forming so many crosses with the opposite pairs—hence the name.

P. ang. divisilobum robustum (divided-lobed, robust), Moly. This belongs to a section of the family in which the pinnules or lobes are again divided, the fronds being really tripinnate, with a peculiarly dense and rich appearance, owing to this extra development. When fully developed, this variety is even again divided, the ultimate divisions being furthermore saw-toothed. Fronds dense, and occasionally proliferous on the stalks.

P. ang. div. laxum (loose), Wills. A distinct form, thrice divided, but not so dense, and with somewhat drooping pinnæ. Very beautiful.

P. ang. div. cristatum (crested), Ivery (6). A real gem, and, being proliferous, easily obtainable; the pinnæ have splendid, spreading, uniform crests, over 2in. wide, and the frond tip a very neat one to match. Well grown, it has no equal in its way.

P. ang. div. plumosum densum (densely feathery), Jones. This Fern is apparently the *ne plus ultra* of division and delicacy. It has been called the *Todea superba* of the British

Ferns, and deservedly so—the fronds, of nearly normal outline, resembling thick masses of the finest moss, the beautifully cut pinnæ and pinnules overlapping each other three deep. This Fern is the latest outcome of careful selection, by Col. A. M. Jones, of Clifton, from several generations of seedlings of a very much divided, but far inferior, wild find. It affords a vivid idea of what our Ferns of the future may become in skilful hands.

P. ang. div. densum (dense), Carbonell. **P. ang. multilobum densum** (many-lobed, dense), Carbonell. **P. ang. div. stipulatum** (stipuled), Carbonell. These three distinct, magnificently dense, and divided forms only rank next to the preceding variety in their peculiarly charming line of variation. For these we are indebted to the late Mr. Carbonell, of Usk.

P. ang. grandiceps (large-crested), Talbot (10). Splendidly tasselled fronds; pinnæ short, and neatly crested.

P. ang. grandiceps, Moly. Another form, with longer pinnæ, forming a triangular frond.

P. ang. grandiceps, J. Jones. The finest of the three. Pinnæ short and curved, with small, dense crests; the end of frond branched repeatedly into huge, much-divided crests. Even more striking than *acrocladon*, being more uniform.

P. ang. Lyellii (Lyell's). Syn. **congestum** (crowded), Lyell. A very dwarf gem, only a few inches high, with densely overlapping, rather curly, pinnæ, same as *Edwardsii* in the Lady Fern.

P. ang. parvissimum (very small). Another dwarf, but larger—7in. to 8in. Pinnules very minute and numerous, and all set as closely as possible, giving a very neat appearance; short, stiff growth. Counterpart of *crispa* in Hard Male Fern.

P. ang. Pateyii (Patey's). Syn. **plumosum** (feathery), Patey (8). Wild find. This is a grand and thoroughly plumose form. Pinnæ very broad and overlapping; thin and delicate in texture, quite barren, and may be regarded as *the* plumose form of the species.

P. ang. plumosum (feathery), Wollaston. Another splendid plumose form, of bolder habit and very delicate foliage.

P. ang. pendens (drooping), Wills. Non-crested form, with extremely large pinnules and drooping habit.

P. ang. polydactylum (many-fingered), Wollaston; and vars. **grande** (large), Jones, and **splendens** (splendid). There have been several distinct finds of *polydactylum*, which is flatly crested, crests consisting of numerous points. The best are those named; all are good.

P. ang. perserratum (prominently saw-edged), Patey. A very beautiful, non-crested form, with pinnules elongated and narrowly and sharply saw-toothed.

P. ang. pulcherrimum (very beautiful), Wills, Padley. Wild finds. Very remarkable and beautiful sports, in which all the lower pinnules are very long and sickle-shaped, and the slender points of the ultimate divisions, in many cases, extend and expand into prothalli, from which plants can be raised by aposporous generation (*vide* Appendix).

P. ang. pulcherrimum, Mrs. Thompson, Moly. Two other finds of same class, Mr. Moly's the finest of all, bearing tiny crests at tips of pinnæ. Apospory is not recorded upon these, and we have not seen the plants; but in Col. Jones' "Nature Prints," lying before us as we write, we believe we detect its existence in both forms.

P. ang. pulch. variegatum (variegated), Moly (7). One of Mr. Moly's luckiest hits, which is saying much. This variety has all the charm described in connection with the last four forms, *plus* the uncommon feature of a distinct, yellow variegation, affecting the greater part of the fronds.

P. ang. proliferum (proliferous), vars. **Allchinii** (Allchin's), **Craufordianum** (Crauford's), **densum** (dense), **Henleyæ** (Henley's), **Lyellii** (Lyell's), and **Wollastonii** (Wollaston's). There are several forms so-called, all interesting, differing generally from the normal in being much more finely cut and attenuated, and in bearing a profusion of young plants at the junctions of the pinnæ with the main stalk. In a close atmosphere these develop several fronds while still attached, forming a dense, moss-like growth along the centre of the frond, and sometimes of the pinnæ. Many of the other varieties present the same character in a less degree—some-

times a solitary bud is formed just where the leafy portion commences.

P. ang. revolvens (rolled back). Pinnules curved back, forming frond into tube.

P. ang. rotundatum (rounded) (11). Very distinct. Pinnules very nearly round.

P. ang. ramo-furcillatum (fork-branched), Allchin. A very much-branched form, fronds and divisions splitting repeatedly, but not cresting.

P. ang. tripinnatum (thrice-pinnate), Gillett, Padley. Very delicate forms, divided to pinnulets.

P. ang. Thompsoniæ (Thompson's) (5). A very beautifully crested form. Wild find.

CHAPTER XV.

THE COMMON BRAKE

(*Pteris aquilina*).

PTERIS AQUILINA is the commonest of all Ferns, and is found under slightly varying forms all over the world; it hardly, therefore, requires description in order to be recognised. Its broad, branching foliage, regardless of the sun and wind, clothes heath and hillside with beautiful verdure everywhere throughout the country, except high up on the hills, where a line seems drawn at the same level as for corn cultivation, beyond which it does not make its appearance. As a species it is distinguished by the spore-heaps forming a continuous margin to the under side of the pinnæ, a characteristic possessed by no other British Fern—this being the sole representative of the family. The young Fern-hunter will do well to practise his apprentice eye upon this Fern, as at least three types of marked variation are almost certain to reward his search in a very short time — viz., the plain, normal form, in which the pinnulets are smooth-edged; a second form, in which they are deeply saw-toothed—in fact, nearly divided again; and, thirdly, a hard, crispy form, in which all the parts are much contracted in width, and somewhat curly. These have been christened *P. a. integerrima, vera,*

and *crispa*, but, though distinct enough to form interesting finds, would hardly repay cultivation. The case is, however, different with regard to those hereafter described, which are highly ornamental. The creeping rootstock of this Fern has a habit of burrowing sometimes 4ft. or 5ft. into the ground, the result of which is that it is almost impossible to remove it successfully, unless it be in winter, when it is dormant, but when, of course, as it is deciduous, varieties cannot be recognised. Fortunately, it is easily raised from spores, which, if ripe, may relieve a fortunate finder from the horns of a dilemma, since, though he may justly claim the find, as its discoverer, the acre or so of land to which it is inseparably attached can hardly be regarded in the same light, apart from porterage difficulties. The best varieties are:

P. a. congesta (crowded). A very fine, dense form.

P. a. cristata (crested). All tips very neatly flat-crested.

P. a. glomerata (clustered). A most extraordinary form, very robust, in which all the pinnules are twisted and curled; and as the ends of the pinnæ do so as well, apparently ball-like crests are formed by the rolled-up masses of pinnules, although, in point of fact, no real crest exists. The central stalk is straight, except at the tip; hence the plant is handsome.

P. a. grandiceps (large-crested). Very heavily crested throughout.

P. a. polydactyla (many-fingered). All tips branching into several points.

P. a. ramo-cristata (branch-crested). Fronds fork repeatedly, bearing numerous crests on the divisions.

PLATE VII.

VARIETIES OF THE HARTSTONGUE

(*Scolopendrium vulgare*).

FIG.

1. *Scolopendrium vulgare supralineatum* (normal outline).
2. „ „ *crispum sagittatum.*
3. „ „ *perae*[illegible]*rens.*
4. „ „ *cristatum,* Millett.
5. „ „ *laceratum* (*endivœfolium*).
6. „ „ *ramo-cristatum,* Moly.
7. „ „ *cristulatum,* Stansfield.
8. „ „ *spirale,* Druery.
9. „ „ *crispum fimbriatum.*
10. „ „ *crispum,* Wills.
11. „ „ *capitatum.*
12. „ „ *sagittato-cristatum,* Hankey.
13. „ „ *sagittato-projectum,* Sclater.
14. „ „ *capitatum Forsteri.*
15. „ „ *grandiceps,* J. Cousins.
16. „ „ *inequale furcans,* Elworthy.

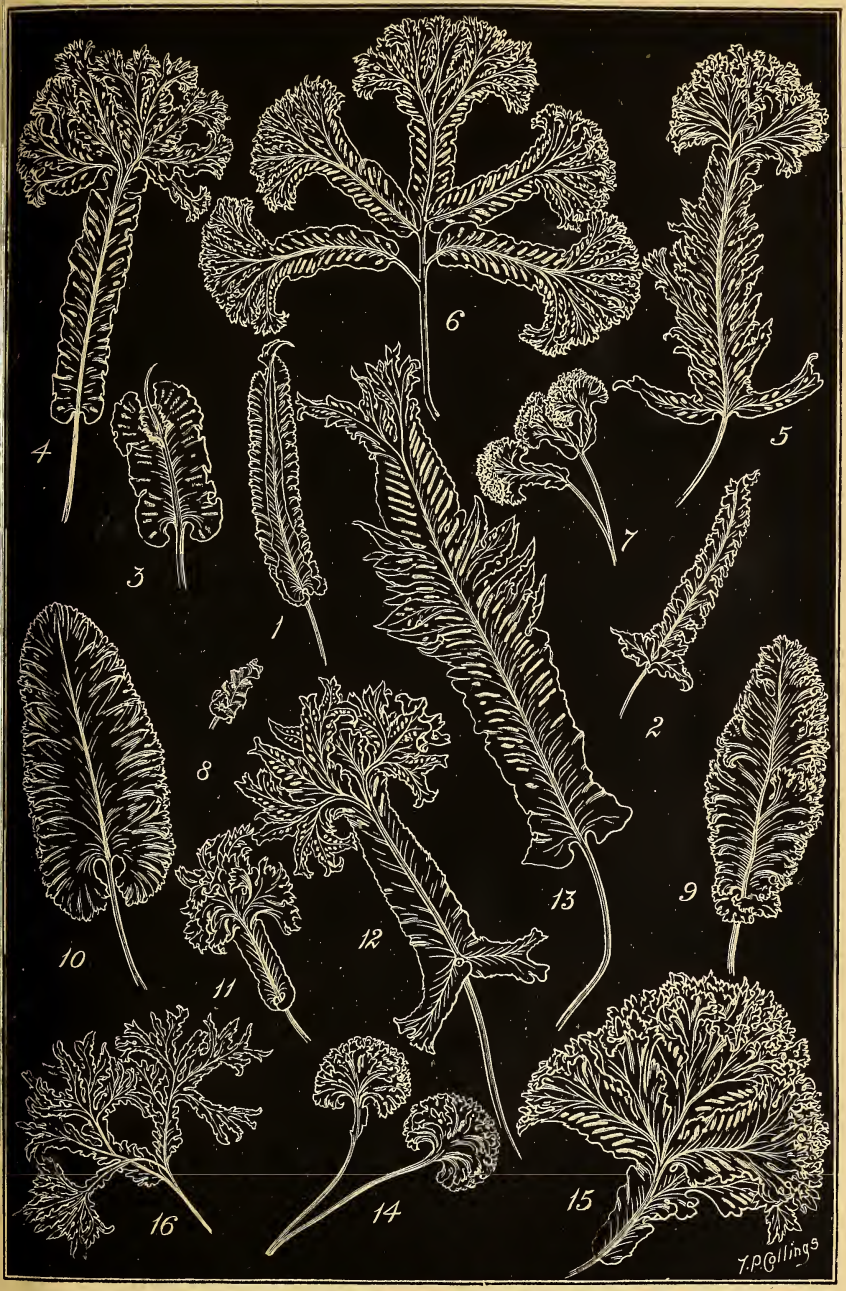

PLATE VII.

VARIETIES OF THE HARTSTONGUE.

CHAPTER XVI.

THE HARTSTONGUE

(*Scolopendrium vulgare*).

NO other British Fern can possibly be confounded with this, at any rate in its common form, its fronds being of a simple, ribbon-like form, heart-shaped at the base, and tapering to a blunt point at the tip. It is the sole British representative of a very small family. Though a comparatively common plant, and one of the least dainty in its likes and dislikes, it is frequently absent from places which seem admirably adapted for it, and where such absence can hardly be imputed to the ravages of the wholesale collector for the market. This is one of the few Ferns which find a congenial home both on walls and in the soil. On the former it is often found in a very stunted form indeed; while the other extreme, in the shape of luxuriant growth, and fronds 2ft. to 3ft. long, will be found revelling in loose vegetable mould, hanging over shaded streamlets, or in the sheltered hollows of tall hedgerows and leafy woods. Cultivation is easy enough: good drainage, an open soil with a trace of lime in it, and plenty of shade and water, are all that is required The fructification in this family consists of long, oval, sausage-shaped heaps of spore-capsules, having a somewhat fanciful

resemblance to the feet of a centipede (*Scolopendra*), whence the botanical name. Its nearest allies are the Spleenworts, from which it differs by there being double, instead of single, lines of fructification; these face each other, and eventually run together when mature, their twin character being thus hidden. In many of the varieties the arrangement *à la* centipede is so much interfered with that the resemblance is entirely upset, the spores appearing in patches of any shape on the edges, and sometimes even on the upper surface of the fronds.

The extremely simple form of the frond of this species would seem, at first sight, to afford very little scope for

FIG. 23.—SCOLOPENDRIUM VULGARE KELWAYII.

variation; but, strange to say, it has yielded forms innumerable, some of them quite peculiar to itself, and of the most odd and unexpected nature, as will be seen by the descriptions of some amongst the following, which, though hardly beautiful, are too curious and too constant in their peculiarities to be ignored. Owing to the immense number of varieties, we can only give a selection of those with which we are personally acquainted, and which embrace the majority of the best known forms. The figures in parentheses refer to Plate VII.

S. v. bimarginato-cordatum (double-margined, heart-

shaped). A long, very much contracted, form, with double marginal ribs at back of fronds, and widish, heart-shaped base.

S. v. cristulatum (small-crested) (7). A very pretty sport; fronds branch low down into several, each tipped with a compact, ball-shaped, moss-like crest.

S. v. capitatum (headed) (11). Fronds normal below, with large, stiff, spiky tuft-crests.

S. v. capitatum Forsteri (Forster's) (14). Dense, rounded crests on bare, branched stalks, with no leafy portion to speak of.

S. v. cervi-cornu (stag's-horn). Fronds small, branching, and contracted, with ragged surface and edges resembling a stag's horn.

S. v. cornutum (horned). Fronds end roundly, midrib projecting from surface, like a thorn.

S. v. conglomeratum (massed together), Ward, and vars. **Baxterii** (Baxter's), **Coolingii** (Cooling's), **Kelwayii** (Kelway's) (*vide* Fig. 28), **Morganii** (Morgan's), and **Wardii** (Ward's). These have short fronds, branching repeatedly, the plants forming a roundish mass of cresting, and bearing bulbils on the extreme edges, which develop into tiny plants while still attached. *Wardii* differs from the others—which are practically alike—in being somewhat smaller and denser.

S. v. congl. densum (densely heaped), Kelway. Raised from bulbil of *Kelwayii;* very dwarf, and the extreme of cresting. Plant like a dense ball of fine moss, with innumerable bulbils in the forks of the divisions.

S. v. corymbiferum (corymb-bearing). A fine, heavily crested form, crests consisting of rounded lobes.

S. v. crispum (crisped), vars. Wills; Bowden; **majus** (great), Moses; **robustum** (robust), Stansfield; Clapham; **latum** (wide); and Gray. The *crispum* section represents the plumose form of this species, the leafy portion being very much developed, so that a more or less deep frill is formed on each side the main stalk; the most highly-developed forms are also perfectly barren. The wild finds of this description have been many; and though there are about a dozen forms sufficiently distinct to be easily discriminated by the eye, it would

be impossible to convey the differences clearly in writing. We therefore merely mention the names under which the best simple forms are known, and, as nearly as we can, in order of merit. Wills (10) is magnificent.

S. v. crispum, Mrs. Stabler. Distinct, having very long stalks and pointed fronds; tall, bold grower.

S. v. crispum fimbriatum (fringed), Stansfield (9). A really splendid form, in which the frills are beautifully fringed. This is the offspring of a very inferior form (*undulato-rigidum*), the spores of which generally yield a proportion of this variety among the plants produced.

S. v. crispum fimbr. cristatum (crested). A crested form of last-named variety.

S. v. crispum, Stansfield, Roundstone. Broad, slightly fringed fronds.

S. v. crispum diversifrons (variable-fronded). Fronds variously shaped, often with long, basal lobes, like arrow-barbs.

S. v. crispum multifidum (much-cleft). SYN. **maximum,** Kitson. A very bold grower, with many pointed crests; very fine indeed.

S. v. crispum sagittatum (arrow-headed) (2). A narrow form of *crispum*, with long, pointed basal lobes.

S. v. cristatum (crested). There are a great many slightly different forms to which this name properly applies, the crests varying only in character and size.

S. v. cristatum, Millett (4), is specially fine.

S. v. cristatum, Riall. A very fine form.

S. v. crist. viviparum (viviparous), O'Kelly. A very singular wild find in Ireland, which has short, squarish, pointed lobes on base of fronds, which are pinched up slightly in the centre, just below a neat, semicircular crest. Its great peculiarity consists in the formation on the upper surface, under close treatment, of numerous warty ridges, which develop into clusters of tiny plants. With us it is rather tender. A unique curiosity, and pretty.

S. v. Cousensii (J. Schott Cousens'). A wild find, of very remarkable character, the fronds being repeatedly branched, à la *Wardii*, but forming very much larger, rounded heads

FIG. 29.—SCOLOPENDRIUM VULGARE CRISTATUM VIVIPARUM, O'Kelly.

of foliage, consisting of innumerable small, fan-shaped lobes, of which the late Mr. Thomas Moore counted 166 in one frond,

each of which was again subdivided into smaller lobes. The plant becomes a spherical mass, and bears occasionally marginal bulbils.

S. v. digitatum (digitate). Fronds crested, with wide, flat, spreading divisions.

S. v. fissum (cut). A pretty, narrowed form, with rather crispy, irregularly toothed margins.

S. v. grandiceps (large-crested), Jno. Cousins (15). A splendid, robust variety, with heavy, spreading crests. It is peculiar in bearing frequently a sharp, cockspur-like projection near the bottom of the stalks.

S. v. hemionitioides (Hemionitis-like). A small form, with fronds like barbed arrow-heads.

S. v. inequale furcans (unequal-forked), Elworthy (16). An attenuated form, with ragged edges; fronds branching repeatedly, so as to form one large, irregular, fan-shaped crest.

S. v. keratoides (horn-like). Syn. **inequale cristatum** (unequal-crested). Leafy portion very narrow, and head repeatedly divided into narrow, spreading divisions.

S. v. laceratum (torn). Syn. **endiviæfolium** (endive-leaved) (5). An old variety, but one of the finest; in it the Hartstongue seems to aim at bearing pinnæ like the other Ferns, the margin running out into long, sometimes crested, points; the basal lobes grow long, and bear decided flat crests; and finally, the frond tip bears frequently an enormous, frilly tassel, of great beauty. The plants vary much, the fronds sometimes being merely deeply and irregularly cut in the edges, basal lobes pointed, and terminal crests a small tuft only. It needs close treatment and free growth to display its best character.

S. v. limbo-spermo cristatum (crested). Crests like fine fringe or lace.

S. v. marginatum (margined). A singular form, found in several localities, with a raised line near the under margin of the fronds.

S. v. marg. multiceps (much-crested). Same as last, with much-divided tips to the fronds.

S. v. multifidum (much-cleft). Spreading, flat, divided crests.

S. v. muricatum (prickly). Narrow, thick fronds, with surface like a coarse file.

S. v. mur. inequale (unequal), Jones. Same as last, but crested like a green cockscomb.

S. v. Malcolmsonii (Malcolmson's). One of the finest heavily crested forms.

FIG. 30.—SCOLOPENDRIUM VULGARE RAMO-DIGITATUM.

S. v. peraferens (pocket-bearing) (3). A most curious sport. Fronds normal for an inch or so from the bottom, abruptly concluding with a frilled pocket, the midrib projecting like a thorn.

S. v. polycuspis undosum (many-cusped, waved). Fronds variously branched, and sometimes twisted, ending in numerous sharp points.

S. v. ramo-cristatum (crested, branched), Clapham. An exceedingly fine form. Fronds branch low down into several, each bearing dense, heavy crests.

S. v. ramo-cristatum, Moly (6). A unique wild find, of extraordinary beauty. Our illustration is from a Nature Print, and therefore obviates further description, as well as suspicion of exaggeration.

S. v. ramo-digitatum (digitately branched). See Fig. 30. Similar, but cresting with wider and flatter divisions.

S. v. ramo-marginatum (branched, margined). Similar form again, but with the contracted and lined character of *marginatum* in the leafy portion and elsewhere.

S. v. sagittato-cristatum (arrow-head-crested), Dadds. A most peculiar sport; fronds narrow, and crested, with very long, basal lobes, also crested, to match.

S. v. sagittato-cristatum, Hankey (12). A much finer form in its cresting than the last; basal lobes shorter, and leafy portion wider.

S. v. sagittato-projectum (projecting), Sclater (13). A splendid, robust variety, akin to *laceratum,* but with sharper projections at sides, and three times the size.

S. v. sagittato-projectum, Westropp. A recent wild find, excelling the last, with wavy, deeply-cut margins, long basal lobes, and crested.

S. v. sag.-proj. variegatum (variegated). Offspring of, and same form as, preceding, but of a decided yellow colour; very distinct and handsome.

S. v. subcornutum (slightly horned). Like *cornutum,* but with projecting midrib at back of frond.

S. v. spirale (spiral), Druery (8). An extremely dwarf form, with numerous thick, short, leathery fronds, twisted like a corkscrew.

S. v. sp. ramosum (branched). Offspring of last, with branching fronds.

S. v. supralineatum (lined above), Jackson (1). Fronds of nearly common outline, but with well-defined, sharp ridges midway between stalk and margin on upper surface; the converse of *marginatum.*

S. v. transverso-lobatum (transversely lobed). Frond divided near top; divisions cross each other, and then crest heavily.

S. v. undulatum (wavy). Intermediate between normal and *crispum.*

S. v. undulato-rigidum (rigidly wavy). Stiff-growing, fertile form of *crispum.* Spores yield a proportion of *crispum fimbriatum.*

S. v. undulato-supralineatum (wavy, lined above), Jones. A superior form of *supralineatum* with wavy margins.

S. v. unguiceps (claw-crested). A curious, narrow form, dividing into a sort of claw-like crest.

CHAPTER XVII.

THE WOODSIAS

(*W. ilvensis* and *W. hyperborea*).

WE bracket these two species together for several reasons. In the first place, though very pretty little Ferns, they are too rare to figure much in popular collections; and in the second, they have afforded no varieties. They resemble each other closely, *W. hyperborea*, the smaller of the two (see Fig. 31), bearing fronds about 4in. high, provided with pinnæ of an oval outline, their edges cut into a few rounded lobes. They are covered with short hairs. The fructification is peculiar, the spore-cases, in roundish patches, being partially covered, or, rather, fenced in, with numerous long, narrow scales, curved inwards, and interlacing in the early stages. It is also peculiar in the fronds having a joint near the base, at which point they drop off when the autumn comes. The plants grow in pretty little tufts, and are only found in high mountain regions, in the clefts and crevices of damp rocks. Cultivation accordingly. Deciduous.

FIG. 31.—WOODSIA HYPERBOREA.

CHAPTER XVIII.

THE FILMY FERNS.

OF these beautifully delicate forms of vegetable life the families all over the world are comparatively few, though the species are fairly numerous. In Britain we have three species, representing two families—viz., *Hymenophyllum tunbridgense* and *H. unilaterale*, commonly called the Tunbridge Filmy Fern and the one-sided Filmy Fern, and *Trichomanes radicans*, or the Killarney Fern, frequently called also the Bristle Fern—of which we will give a short description under each heading, referring our readers to Chapter VI., in our first section, for remarks regarding their cultivation.

The Tunbridge Filmy Fern

(*Hymenophyllum tunbridgense*).

THIS very delicate and charming little Fern is admirably illustrated in Fig. 32, and hence we need not describe its form. In colour it is a very dark, semi-transparent green, and when well grown it forms a dense mat, the tiny, hair-like, creeping roots interlacing thickly with each other, and throwing up an immense number of fronds. This species, like all its relations, only thrives within the humid influences of running water, and is at home within reach of the spray of mountain cascades, where it may be found lining the crevices of the rocks, and forming a lovely tapestry upon their surfaces. It

received its name through being found at one time at Tunbridge, in Kent, to which place, however, it is by no means confined, though unscrupulous Fern-hunters have rendered it tolerably scarce in many of its former haunts. It is precisely one of those Ferns that a true lover of Nature should gloat over *in situ* and leave alone, unless he is sure he can grow it. Mr. Shirley Hibberd mentions that he once saw *a square*

FIG. 32.—THE TUNBRIDGE FILMY FERN (*Hymenophyllum tunbridgense*).

yard of this beautiful plant, *dried and rolled up*, figuring in a lady's collection of souvenirs of her travels. This item should have figured in our chapter on Fern Foes, but it fits here equally well. The spore-capsules of this Fern are borne in comparatively large, urn-shaped receptacles, on the edges of the tiny fronds. No varieties have been found as yet.

The One-sided Filmy Fern

(*Hymenophyllum unilaterale*).

THE difference between this Fern and the last is indicated clearly enough by Fig. 33, which also shows the very

peculiar spore-vessel of this species, and its place of attachment. It frequents precisely the same haunts as the Tunbridge

FIG. 33.—THE ONE-SIDED FILMY FERN (*Hymenophyllum unilaterale*), showing Habit, and detached Pinna with Involucre.

Fern, but is, perhaps, a trifle more common. The fronds are not unfrequently forked, but no symmetrical variety has yet been found.

The Killarney Fern

(*Trichomanes radicans*).

THIS is, undoubtedly, the king of the Filmy Ferns of Britain, and, in point of fact, can claim a foremost place amongst those of the world generally, rivalling the best in bold growth and delicate beauty. The fronds, which are roughly triangular in shape, grow, under favourable conditions, to over 1ft. in length, of which from a third to one-half will constitute the stalk; they are beautifully divided, the pinnulets being deeply cut. The colour is a delicate green, and the texture tough, though the

translucent appearance misleads the eye in this respect. The root is a creeping one, and, when once the plant is established, speedily makes its way about and produces fronds freely, though these very slowly acquire full development. Under congenial circumstances they remain green for years.

Killarney is by no means the only home of this Fern, as, besides having a wide geographical range outside Britain, it has been found in many other places in Ireland, also in Wales; and one reliable record exists of a Yorkshire find. Naturally, a Fern constituted like this can only exist in an atmosphere saturated with moisture; hence its home is by the side of, or, it may be, behind, the plashing cascade, wherever the wind is warded off by the friendly water—to say nothing of the too inquisitive, and, alas! too acquisitive, Fernist (a distinct species from the Fern-*lover*).

The fructification consists of deep, cup-shaped receptacles, sunk in the edges of the pinnæ, the spore-capsules being attached to a long bristle in its centre, which projects more or less from the said receptacle; whence the name Bristle Fern, commonly applied to this species, and also its botanical name of *Trichomanes*.

For cultivation, see Chapter VI., first section.

This Fern has sported freely, considering its rarity. The most marked varieties are:

T. r. Andrewsii (Andrews'). Fronds narrower, and pinnæ more distant. Wild find.

T. r. crispum (crisped). A curled, crispy form, very peculiar, branching sometimes irregularly.

T. r. dilatatum (dilated). Fronds much less divided.

T. r. dissectum (dissected). Fronds much finer cut than the normal.

T. r. proliferum (proliferous). A form bearing bulbils.

APPENDIX.

ON THE NEWLY-DISCOVERED PHENOMENON OF APOSPORY IN FERNS.

[*Reprinted, by permission, from the* LINNEAN SOCIETY'S JOURNAL—BOTANY, vol. xxi.]

Observations on a Singular Mode of Development in the Lady Fern (*Athyrium Filix-fœmina*). By CHARLES T. DRUERY. Communicated by Dr. J. MURIE, F.L.S.

[Read 19th June, 1884.]

THE reproduction of the *Filices* by their spores results from sexual action taking place upon the under surface of the prothallus to which the spore gives rise. So far, I believe, no development of the perfect prothallus has been observed without the agency of the spore, and the following record of such a case therefore deserves special notice.

Some years ago, a very distinct and beautiful form of *Athyrium Filix-fœmina* was found wild by Mr. Moule, in North Devon, from whose possession it passed into that of Col. Jones, of Clifton. Many attempts were made at the time to propagate

it from what were assumed to be spores, always, however, without success; and at length it was taken for granted that the peculiar growths produced by this Fern in the place of sori were merely abortive spore-cases, and that the plants, like some other abnormal forms, lacked the special vigour necessary for the formation of perfect reproductive spores. All further attempts at raising it were consequently abandoned; and only two divisions of the plant exist.* In the autumn of 1883 I discovered upon another *Athyrium* (*A. F.-f.*, var. *plumosum divaricatum*), numerous proliferous bulbils, occupying the place of sori on the back of the fronds, and, reporting this to Mr. G. B. Wollaston, he was led to re-examine *A. F.-f. Clarissima*—as the Fern in question had been named by Col. Jones—and came to the conclusion that these so far barren excrescences might be viviparous growths of a kindred nature, and capable of reproducing the parent form by direct bud-development. A portion of a frond was consequently sent to me, and upon examining it under the microscope, I found that there were very material structural differences between the unmistakable bulbils of *A. F.-f. divaricatum* and the singular growths upon *A. F.-f. Clarissima*, the former being solitary, bud-like growths, seated in the centre of a number of brown, lanceolate scales, and without a trace of indusium; while the latter were composed of five or six or more flask-shaped bodies, each one larger than the bulbils aforesaid, and seated within an undoubted indusium. The masses were sufficiently large for their formation to be clearly distinguishable by the naked eye, covering more than the space of an ordinary sorus. At this stage no signs of spores or spore-cases could be detected, nor could any axis of growth be perceived; so that it was impossible to form any theory as to the eventual mode of reproduction which might result; for although the tips of the flask-shaped pseudo-bulbils were in some cases elongated into filiform processes, no sign of

* It is, of course, open to question whether the excrescences formed prior to 1883 were of exactly the same nature. Col. Jones inclines to the belief that they approached more nearly the character of sori, and did not in previous years present the same appearance as now described.

circination or resemblance to fronds was visible; added to which, the presence of an indusium, in the place of the scales common to true bulbils, led to the assumption that they were abnormal sporoid growths, and not proliferous ones, likely to produce plants by direct bud-growth.

To test their capabilities I laid down, on Nov. 27, in a duly prepared seed-pan, numerous pinnæ, which I embedded edgewise, halfway in the soil, the growths being thus brought into immediate contact with it, lying as they did along the rhachides of the pinnæ. I then placed the pan in slight heat, with the result that the pseudo-bulbils immediately began to increase in size, and to develop in such a fashion that on Dec. 24 I was able to record an evident foliaceous extension and division of the tips of the pseudo-bulbils, and the appearance of numerous long, rigid, glassy-looking rods or hairs, which sprang from their bases. These rods bore a strong resemblance to the root-hairs common to the undersides of prothalli; but their decided upward growth, radiating stiffly, seemed opposed to this view, as also the fact that they sprang from the bases and sides of the pseudo-bulbils. It is probable, however, that they acted as aërial roots, for the growth of the tips of the pseudo-bulbils proceeded rapidly, until, on Feb. 10 of the present year, I recorded that they had assumed a decided prothalloid form, while the upright rods had either become deflected or absorbed. Eventually, all the tips of the flask-shaped bulbils assumed the form of perfect prothalli of the usual size and shape, the pseudo-bulbils themselves being absorbed and disappearing, and the usual root-hairs developing under the prothalli. On March 17 several of these prothalli were examined microscopically, both by myself and by the Rev. Mr. Aubrey, of Salisbury (to whom I am indebted for aid in observing the final stages of growth), and well-developed archegonia were found in the usual place and number, but so far neither of us was able to detect antheridia. Early in May, however, I succeeded in finding a single antheridium; and it is manifest that many others must have been present on the prothalli not examined, as on May 21 the final stage was reached, small fronds

being visible in several cases, projecting from the bifurcation of the prothallus, and evidently, therefore, produced from the archegonia by the ordinary sexual mode of reproduction; though the prothalli, as has been shown, had developed from growths that differed widely from spores in their form, their size, persistent adherence to the pinnæ, their production of root-hairs from their surface, and, finally, in the development of the prothallus from their apices by simple extension of growth.

Lest it might be assumed that these prothalli may after all have resulted from true spores scattered amongst the excrescences described, it should be borne in mind—first, that no spores or spore-cases could be distinguished when the pinnæ were laid down; secondly, that all attempts to raise this Fern from spores have failed; and finally, that the entire development of the prothallus from the pointed tip of the pear-shaped pseudo-bulb—its dilatation, bifurcation, and gradual assumption of the true prothallus form—has been carefully watched and noted step by step, not merely in one case, but in many, in all of which the prothallus was evolved precisely in the same way.

Where, as in this case, the whole phenomenon is new to the observer, many points of interest are apt to be overlooked, their importance being unknown until too late. Another season's growth may therefore confidently be expected to throw more light upon this development, and especially in relation to the first appearance of the pseudo-bulbils themselves, which only came under close observation when already of considerable size.

In framing this account of the occurrence, I have confined myself as strictly as possible to a simple, and I hope clear, record of the phenomena observed during the various stages of growth of the abnormal sporoid excrescences under observation. In conclusion, however, I may be permitted to point out, in connection with such phenomena, that, so far as formal records are concerned, the family of *Athyria* has hitherto been remarkable for the non-proliferous character of the fronds, which, considering, first, its near relation to the *Asplenia*, so

many of which are profusely proliferous, and, secondly, the protean nature of the family itself, is a singular fact. The discovery, however, of numerous proliferous buds which appeared upon some very small plants which I exhibited here in 1882, led me to institute further inquiries into this subject. I then ascertained that Mr. Mapplebeck had already observed the same phenomenon, and raised plants from similar bulbils, which appeared identical in position and character with those of the *Asplenia*. Last year, as already remarked, I found another and very distinct form of proliferation on a mature plant of *A. F.-f. plumosum divaricatum*, upon which numerous bulbils were evolved in the place of the sori, this, be it observed, being on the under side of the pinnæ, a most unlikely place for such growths. This same transformation of the reproductive energy had already been observed on three other kindred forms of *Athyrium*, upon one of which the bulbils and sori were scattered almost indiscriminately over the back of the fronds, some of the sori seeming to be in an intermediate amorphous condition; though in all other cases, so far as I could see, the sori and bulbils were distinctly differentiated by the presence, in the former case of an indusium, and in the latter of lanceolate scales arranged shuttlecock fashion around the bulbil, no trace of indusium existing. Such bulbils had, until this season, failed invariably to yield plants, and seemed incapable of forming a proper axis of growth. Mr. G. B. Wollaston has, however, succeeded in obtaining plants this spring from *A. F.-f. plumosum elegans*, and one or two of those from *A. F.-f. plumosum divaricatum* have developed fresh fronds with me.

From this it will be seen that no less than three distinct forms of proliferation have now been observed on the *Athyria*:

1. Bulbils of the ordinary character, developed in the axils and on the superior surface of the pinnæ, and agreeing in character with the ordinary bulbils of the *Asplenia*.

2. Bulbils formed apparently by transmuted spore-producing energy, and occupying the place of sori, *i.e.*, on the under side of the pinnæ—a position so far, I believe, quite unrecorded in connection with any of the *Filices*.

3. A new form of proliferation altogether, viz., proliferous prothalli arising from pseudo-bulbils produced by a different transmutation of the reproductive force, and evolving plants only after the prothalli have produced the usual sexual organs common to prothalli resulting from spores.

Further Notes on a Singular Mode of Reproduction in *Athyrium Filix-fœmina*, var. *Clarissima*. By CHARLES T. DRUERY. Communicated by Dr. J. MURIE, F.L.S.

[Read 20th November, 1884.]

AT a meeting of the Linnean Society in June last I had the honour of bringing before your notice a record of certain phenomena which I had observed during the past winter in connection with the reproduction of a form of *Athyrium Filix-fœmina* through prothalli, which were not produced from

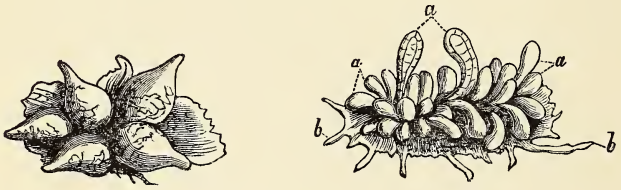

FIG. 34.

A—Pyriform Pseudo-bulbils or Abnormal Sporoid Growths of 1883, enlarged.
B—*a*, Clavate Abnormal Sporoid Growths of 1884; *b*, Ragged Indusium.

spores, but from certain excrescences evolved in their stead upon the under surface of the pinnæ. The *Athyrium* in question, which was found wild in Devon, had been for many years reputed barren, the fructification, which appeared copiously, yielding no perfect spores, the result being that after a long period only two plants existed, the original plant having permitted but one division. In 1883, one of these plants, which had been grown under cover, was observed to produce upon the inferior surface of the pinnæ a large

number of curious excrescences, consisting of pear-shaped, bulbilloid growths, attached firmly to the frond by their thicker extremities, and seated in every case within indusia, thus occupying the place of sporangia, to which, however, they bore no resemblance whatever. Mr. G. B. Wollaston, whose attention was drawn to them by the previous discovery of bulbils proper upon other *Athyria* in the same year, which bulbils also occupied the place of sori, was of opinion that they were also bulbils. However, on comparing them with the bulbils produced on these other *Athyria*, I was struck by the fact that, while in the other cases the bulbils were seated in the centre of scales arranged shuttlecock fashion around them, in this case indusia were present instead, which led me to look upon them as sporoid growths of a character essentially different from the bulbils common to many Ferns. I consequently laid down a number of pinnæ, with the result that I read before you in June, viz., the production of perfect prothalli by the bifurcation of the points of the pear-shaped pseudo-bulbils, which prothalli eventually developed archegonia and antheridia, and finally yielded plants of the same type as the parent.

At the meeting in June I could do no more than lay the consecutive record of my observations before you, since all traces of the preliminary stages had vanished when the young plants appeared, and these were then too diminutive for their character to be determined; they also afforded no evidence whatever that they had originated in other than the usual way, viz., from spores, and I consequently did not exhibit them.

To-night, however, I have pleasure in exhibiting some of the plants produced as I have described. I had hoped, too, to be able to bring pinnæ bearing pseudo-bulbils as described and sketched by me last year; but owing, partly, I believe, to the long, dry summer, and partly to the fact that the parent plant (which is not under my control) was placed out of doors for a time, I am only able to produce pinnæ showing the fructification in a very immature state—not so immature, however, but that they afford ample evidence of abnormality.

To anyone accustomed to deal with *Athyrium Filix-fœmina*, the first glance will strike one with surprise at the presence of fresh, green, unripe fructification with, in most cases, unlifted indusia, upon a deciduous Fern in November, months after the time when sporangia proper have ripened and scattered their spores, and when the indusia are usually in a ruinous and fragmentary state. Here and there the indusia on the pinnæ exhibited will be seen to be lifted and to partially disclose a number of curious, club-shaped and occasionally serpentine, cellular masses which, though very different from the swollen, pear-shaped bodies of last year, differ as widely from embryo sori, showing no signs whatever of annulation or of the symmetry which would characterise immature sporangia when sufficiently advanced to protrude from the indusium. While, however, the pear-shaped pseudo-bulbils are conspicuous by their absence, it will be seen that some of the club-shaped excrescences are larger than others. From their general appearance, I believe that, given a more favourable season, some few would assume predominance, and form the pear-shaped pseudo-bulbils at the expense of the weaker growths, which would abort, as in many analogous cases. I incline the more strongly to this opinion, as among the bases of the pear-shaped bodies produced last year there were numerous thin, thready, and shapeless growths, exactly such as would be likely to originate in such a way.

My present object being to confirm as far as possible the data I gave in June, I would call your attention—first, to the existence of the young plants upon the table, raised as described; and, secondly, to the manifestly non-soriferous form of fructification borne by the parent plant, an examination of which will, I think, go far to convince you that its offspring are engendered neither through spores nor by bulbils, but by some other mode of reproduction—a mode which, from constant and careful watching through all its stages, I believe to be one so far unrecorded in connection with any other Fern—viz., through prothalli produced, not from spores, but by direct bud-growth from the parent frond.

On Apospory in Ferns (with special reference to Mr. Charles T. Druery's Observations). By F. O. Bower, M.A., F.L.S. (Extract).

[Read 18th December, 1884.]

Mr. C. T. Druery has already drawn the attention of the Society, in two successive papers, to *Athyrium Filix-fœmina*, var. *Clarissima*, ascribing to that plant a mode of transition from the sporophore generation (or Fern-plant), to the oophore (or prothallus), without the intervention of spores. He has pursued the subject with success, as far as it is possible without subjecting the matter to a detailed microscopical investigation. We are indebted to this observer, not only for the communications already received from him, but also for his generosity in supplying to the Royal Gardens at Kew material fitted for the more detailed microscopical analysis of the process. Without further recapitulation of Mr. Druery's results, I may at once proceed briefly to describe the observations which I have made on the cultures now in progress at Kew. Many minute details will be deferred for the present, till the investigation is completed; the chief results are, however, of such importance as to justify a preliminary notice of them.

The sori in *Athyrium Filix-fœmina*, var. *Clarissima*, appear in the normal position with a normal indusium. In the condition in which the specimens were when first I received them (Nov. 29), the large majority of the sporangia presented an abnormal appearance. Some few appeared of nearly normal structure, with an annulus, but were arrested at a point of development before the formation of the spores; others, and indeed the majority of them, showed more or less distinctly the central *archespore*, together with the cells which would normally form the wall of the sporangium; but there the normal development seemed to have been suddenly arrested —the archespore had not in these cases divided further to form either the tapetum or the mother-cells of the spores. The arrest of development of the archespore is, however, compensated in these cases by the more active vegetative development of the stalk of the sporangium and of the superficial cells of

the head, the result being that the arrested sporangium ultimately appears as a club-shaped body of larger size than the normal sporangium. The individual cells also are of larger size; they contain numerous chlorophyll granules, which, if present at all in normal sporangia, are relatively few in number. Further, the more rudimentary the head of the sporangium is, the more marked is the vegetative development of the remaining parts.

If pinnules showing the above characters be subjected to favourable conditions of heat and moisture, the vegetative development of the sporangia may proceed at once. On pinnules laid on damp soil, and forced quickly in the propagating-pits at Kew, the earlier stages of this further development have been traced. The details show great irregularity; and they are found to correspond to the greater or less completeness of arrest in the normal development of the sporangium. Thus, sporangia which show a clearly marked annulus do not usually assume any further vegetative activity; those, however, which are arrested at an earlier stage in their normal development may produce, by a purely vegetative process, outgrowths of very irregular form. Sometimes all the superficial cells of the club-shaped body may take part in the process, and this is most clearly seen where the arrest of the normal development is most complete. In other cases the head of the arrested sporangium may be thrown off, while the stalk continues its vegetative growth. The result is in either case the formation of flattened structures, consisting only of parenchymatous, chlorophyll-containing cells, which, sooner or later, show at one or more points on their margins that growth with a wedge-shaped, apical cell, which is well known as characteristic of the Fern prothallus; root-hairs are at the same time formed by the outgrowth of individual cells. None of my cultures have as yet formed sexual organs: this we must wait for; but meanwhile it may be remarked that Mr. Druery's observations during the last two years show that, in the cases observed by him, sexual organs were formed, and young Fern-plants were produced by them. In any case, however, the above observations show that in the

Fern in question there is a transition from the sporophore generation to a structure of a prothalloid nature, without the intervention of spores, and that it is formed, by a process of purely vegetative growth, from more or less reduced sporangia. Finally, it may be stated that my observations do not exclude the possibility of a formation of such structures by a vegetative outgrowth of the base of the sorus itself; whether this actually occurs must be decided by further investigation.*

Through Mr. Druery I have Mr. G. B. Wollaston's permission to mention a still more interesting example of apospory, of which the latter gentleman is the discoverer, viz., *Polystichum angulare*, var. *pulcherrimum*. Here flattened organs, of undoubted prothalloid nature, are formed by simple vegetative outgrowth of the tips of the pinnules, and without any connection with sori or sporangia. At first the tip of the pinnule merely extends, so as to form a flattened expansion one layer of cells in thickness, and with a very irregular margin; while the whole tip curves downwards, and often forms a spiral coil of one or one and a half turns, closely covered above by the more expanded portion of the pinnule. In other cases the outgrowth may assume very irregular forms. Ultimately the characteristic marginal growth begins at some point, sometimes terminal, but more frequently lateral. The details of this development have not yet been fully investigated. The result, however, is the formation of a flattened, often heart-shaped, expansion, with a thickened cushion similar in structure to that found in normal prothalli; it bears antheridia and archegonia of normal structure; sometimes, as occurs also in ordinary prothalli, they are found both on the lower and upper surfaces. A point worthy of note is that in those prothalloid structures which are taken directly from living leaves in the normal position, without further cultivation, the antheridia and archegonia have not opened; no doubt this is due to the want of water, which, as is well known, is necessary for this process. I have not yet been

* Since the above was written the cultures at Kew have progressed, so that prothalli bearing archegonia and antheridia may be seen, still connected at their bases with the pinnule of the parent plant.—Feb. 11, 1885.

able to observe the formation of young Fern-plants on these prothalli; but it may be hoped that from cultures now in progress at Kew and elsewhere further evidence may be obtained on this point.

This Polystichum is thus an example of the formation of an expansion of *undoubted prothalloid nature*, bearing sexual organs by a process of purely vegetative outgrowth from the Fern-plant—that is, there is a transition in this case from the sporophore generation to the oophore by a vegetative growth, and without any connection either with spores or, indeed, with sporangia or sori. It may be regarded as a still more complete example of *apospory* than that of *Athyrium Filix-fœmina*, var. *Clarissima*.

INDEX.

A.

Adderstongue (Ophioglossum vulgatum), 9, 98
Adiantum Capillus-Veneris, 28, 32, 71
C.-V. cornubiense, 71
C.-V. daphnites, 72
C.-V. magnificum, 72
C.-V. plumosum, 72
cuneatum, 71
Allosorus crispus, 28, 73
crispus cristata, 73
Aniline dyes, 8
Antheridia, 38
Antherozoids, 38
Antiquity of Fern family, 7
Apogamy, 40
Apospory, 33, 40, 130, 149
Archegonia, 37
Asplenia, the (Plate II.), 28, 29, 76
Asplenium Adiantum-nigrum, 77
A.-n. caudifolium, 78
A.-n. cristatum, 78
A.-n. grandiceps, 78
A.-n. microdon, 78
(Athyrium) Filix-fœmina, 85
Ceterach (Ceterach officinarum), 28, 29, 84
fontanum, 82
f. refractum, 82
germanicum, 83
lanceolatum, 78
l. cristatum, 78
l. microdon, 78
marinum, 28, 78
m. capitatum, 78
Asplenium marinum imbricatum, 78
m. plumosum, 78
m. ramosum, 78
Ruta-muraria, 83
septentrionale, 83
Trichomanes, 79
T. confluens, 79
T. cristatum, 80
T. incisum, 80
T. Mouleii, 81
T. ramo-cristatum, 81
viride, 81
v., McLean's find, 82
Athyrium Filix-fœmina (Plate II)., 20, 21, 28, 30, 85; buds on, 32, 89, 150
F.-f. acrocladon, 20, 86
F.-f. acr. densum, 86
F.-f. acr. laciniato-acrocladon, 86
F.-f. acr. magnicapitatum, 86
F.-f. acr. ramosissimum fimbriatum, 86
F.-f. acr. unco-glomeratum, 86
F.-f. acr. velutinum, 86
F.-f. alpestre, 85
F.-f. Applebyanum, 88
F.-f. Clarissima, 87, 150
F.-f. congestum, 87
F.-f. cong. cristatum, 87
F.-f. cong. minus, 87
F.-f. corymbiferum, 87
F.-f. crispum, 87
F.-f. cristatum, 87
F.-f. Edwardsii, 87
F.-f. Elworthii, 87

Athyrium F.-f. Fieldiæ, 87
F.-f. Findlayanum, 87
F.-f. Frizelliæ, 88
F.-f. Friz. cristatum, 88
F.-f. Friz. ramosissimum, 88
F.-f. Friz. ramosum, 88
F.-f. Girdlestoneii, 88
F.-f. glomeratum, 88
F.-f. Grantiæ, 87
F.-f. Kalothrix, 88
F.-f. orbiculare, 89
F.-f. percristatum, 89
F.-f. plum., Axminster, 21, 89
F.-f. plum., Barnes, 90
F.-f. plum. cristatum superbum, 21, 90
F.-f. plum. elegans, 21, 89, 153
F.-f. plum. divaricatum, 90, 153
F.-f. plum., Horsfall, 89
F.-f. plum. multifidum, 90
F.-f. pulcherrimum, 90
F.-f. ramulosissima, 90
F.-f. reflexum, 90
F.-f. regale, 90
F.-f. setigerum, 90
F.-f. set. cristatum, 90
F.-f. splendens, 91
F.-f. Vernoniæ, 91
F.-f. Vern. corymbiferum, 91
F.-f. Vern. cristatum, 91
F.-f. Victoriæ, 20, 35, 91
F.-f. Vict. gracile, 91
F.-f. Vict. magnificum, 91

B.

Beech Fern (Polypodium Phegopteris), 28, 29, 118
Bell-glasses, 59
Bladder Fern (Cystopteris), 32, 100
Fern, Alpine (C. regia), 101
Fern, brittle (C. fragilis), 100
Fern, mountain (C. montana), 101
Blechnum Spicant (Plate III.), 20, 25, 28, 29, 30, 93
S. Aitkenianum, 94
S. cladophorum, 94
S. concinnum, 94
S. congestum, 94
S. contractum, 94
S. crispissimum, 94
S. cristatum, Kinahan, 95
S. crist., Stansfield, 95
S. glomeratum, 95
S. imbricatum, 95
S. lineare, Barnes, 95
S. Maunderii, 95
S. multifurcatum, 97
S. paradoxum, 95
S. polydactylum, 95
S. ramo-crist., Druery, 96
S. ramo-crist., Maunder, 95
S. ramosum, 95
S. serratum, Airey, No. 1, 97
S. serratum, Airey, No. 2, 97
S. sub-plumosum, 97
S. trinervium coronans, 96, 97
S. trinervium, Hodgson, 97
S. trinervium, Phillips, 97
Botrychium lunaria, 9, 98
Bower, Prof. F. O., on Apospory, 157
Bracken (Pteris aquilina), 9, 11, 12, 13, 132
Bristle Fern (Trichomanes radicans), 58, 147
Buckler Ferns (Lastrea), (Plate IV.), 9, 104
Ferns, Broad (L. dilatata), 105
Ferns, Common (L. Filix-mas), 107
Ferns, Hay-scented (L. æmula), 105
Ferns, Lemon-scented (L. montana), 110
Ferns, Marsh (L. Thelypteris), 112
Ferns, Mountain (L. montana), 110
Ferns, Rigid (L. rigida), 112
Buds and bulbils, 23, 31, 32
Bud sports, 20

C.

Camptosorus rhizophyllus, 14
Caterpillars, 62
Caudate forms, 24
Ceterach officinarum, 28, 29, 84
Coal Exchange, fossil Ferns at, 7
Coal, origin of, 7
Congestion, 23
Cool treatment, need for, 61
Cork baskets, &c., 45
Cornute forms, 24
Cristation, 22
Cryptogramme crispa, 28, 73
Culture, 27
Cystopteris, 32, 100
  alpina, 101
  fragilis, 100
  f. Dickieana, 101
  f. Dick. crispa, 101
  f. sempervirens, 101
  f. semp. cristata, 101
  montana, 101
  regia, 101

D.

Depauperation, 24
Division, Fern mode of, 31
Drainage, 27
Dwarf forms, 23

E.

Economic value of Ferns, 8
Evolution in Ferns (Plate I.), 21, 90

F.

Ferneries, 56
  in windows, 57, 60
Fern foes, 61
  hunting, 7, 10
  pots, pans, &c., 45
Fern wall-tiles, Booty's, 51
Ferns, antiquity of, 7
  deciduous, 29
  distinctive characters of, 9, 36
  economic value, 8
  evergreen, 29
  fecundity of, 13, 35
  filmy, 32, 58, 59, 145
  fossil, 7
  inconstancy in, 20, 22, 96
  in sunny gardens, 53
  vitality of, 15
Flower-pots, Scotch, 54
Fossil Ferns, 7
Fumigation, 65

G.

Green-fly, 64
Grubs, 62
Gymnogramma leptophylla, 102
Gymnogram, small-leaved (G. leptophylla), 102

H.

Habitats, congenial, 8
Hard Fern (Blechnum Spicant), (Plate III.), 20, 25, 28, 29, 30, 93
Hartstongue (Scolopendrium vulgare), (Plate VII.), 9, 13, 14, 20, 24, 25, 28, 29, 42, 135
Holly Fern (Polystichum Lonchitis), 125
Hybridisation, 43
Hymenophyllum tunbridgense, 58, 59, 145
  unilaterale, 58, 59, 146

I.

Inconstancy in Ferns, 20, 22, 96
Indusium, 71

K.

Kew, collection at, 3
Killarney Fern (Trichomanes radicans), 58, 147

L.

Lady Fern (Athyrium Filix-fœmina) (Plate II.), 20, 21, 28, 30, 85; buds on, 32, 89, 150
Lastreas (Plate IV.), 9, 104
Lastrea æmula, 105
æmula cristata, 105
dilatata, 105
d. alpina plumosa, 106
d. crispata cristata, 106
d. cristata gracilis, 106
d. foliosa-cristata, 106
d. foliosa-digitata, 106
d. grandiceps, 106
d. Howardii, 106
d. lepidota, 106
d. polydactyla, 106
Filix-mas, 12, 107, 109
F.-m. Barnesii, 109
F.-m. Bollandiæ, 109
F.-m. cristata, 110
F.-m. fluctuosa, 110
F.-m. grandiceps, Berry, 110
F.-m. grandiceps, Sim, 110
F.-m. grandiceps, Wills, 110
F.-m. linearis, 110
montana, 29, 110
m. Barnesii, 111
m. congesta, 111
m. coronans, 111
m. cristata, 111
m. grandiceps, 111
m. Nowelliana, 111
m. plumosa, 112
m. ramo-coronans, 112
propinqua, 107, 110
p. crispata incisa, 110
p. cristata, 110
p. grandiceps, 110
pseudo-mas, 29, 107
Lastrea pseudo-mas crispa, 108
p.-m. crispa cristata, 108
p.-m. crispa cristata angustata, 108
p.-m. crispa gracilis, 108
p.-m. cristata, 31, 40, 107
p.-m. crist. angustata, 108
p.-m. polydactyla, Dadds, 108
p.-m. polydactyla, Mapplebeck, 108
p.-m. polydactyla, Wills, 108
p.-m. ramo-cristata, Fitt, 109
p.-m. ramulosissima, 25, 109
p.-m. revolvens, 109
p.-m. Schofieldii, 109
oreopteris (L. montana), 29, 110
recurva (L. æmula), 105
rigida, 112
Thelypteris, 28, 112
Lemon-scented Fern (Lastrea montana), 29, 110
Light, necessity of, 64
Lomaria Spicant (Blechnum Spicant), 93
Lowe's, E. J., "Our Native Ferns," 2

M.

Maidenhair Fern (Adiantum Capillus-Veneris), 28, 32, 71
Male Fern, Hard (Lastrea pseudo-mas), 107
Fern, Intermediate (L. propinqua), 110
Fern, Soft (Filix-mas), 109
Marginate forms, 24
Marsh Fern (Lastrea Thelypteris), 28, 112
Moonwort (Botrychium Lunaria), 9, 98

N.

Nature Prints, Col. Jones's, 4
Prints, Moore's, 2
Nephrodium (Lastrea) (Plate IV.), 9, 104

O.

Oak Fern (Polypodium Dryopteris), 28, 29, 117
Ophioglossum vulgatum, 9, 98
Osmunda regalis, 40, 113
regalis cristata, 114
r. ramo-cristata, 114

P.

Parsley Fern (Allosorus crispus), 28, 73
Plumation, 23
Polypodium calcareum, 118
Dryopteris, 28, 29, 117
Phegopteris, 28, 29, 118
P. multifidum, 119
Robertianum (P. calcareum), 118
vulgare (Plate V.), 9, 11, 25, 28, 29, 32, 35, 119
v. bifido-cristatum, 44, 120
v. cambricum, 20, 120
v. camb. Prestonii, 120
v. Claphamii, 44, 121
v. cornubiense, 120
v. cristatum, 121
v. crist., Forster, 121
v. crist., Scarboro', 121
v. elegantissimum, 44, 120
v. Fowlerii, 120
v. glomeratum, 122
v. grandiceps, 122
v. grandiceps, Parker, 122
v. multifido-cristatum, 122
v. omnilacerum, 122
v. parvissimum, 122
v. plumosum, Hadwin, 122
v. pulcherrimum, 122
v. ramosum, Hillman, 122
v. trichomanoides, 120
Polypody, Common (Polypodium vulgare) (Plate V.), 9, 11, 25, 28, 29, 32, 35, 119
Limestone (P. calcareum), 118
Polystichums (Plate VI.), 9, 22, 25, 28, 29, 124
Polystichum aculeatum, 125
ac. acrocladon, 126
ac. acutilobum, 126
ac. corymbiferum, 126
ac. cristato-gracile, 126
ac. pulcherrimum, 126
angulare, 126
ang. acrocladon, 127
ang. attenuato-cristatum, 127
ang. brachiato-crist., Keall, 127
ang. brachiato-cristatum, Wills and Gray, 127
ang. capitatum, 128
ang. congestum, 128
ang. crispato-foliosum, 128
ang. cristato-gracile, 128
ang. cristatum, Wollaston, 128
ang. cruciatum, 128
ang. divisilobum cristatum, Ivery, 128
ang. div. densum, 129
ang. div. laxum, 128
ang. div. plumosum densum, Jones, 128
ang. div. robustum, 128
ang. div. stipulatum, 129
ang. grandiceps, J. Jones, 129
ang. grandiceps, Moly, 129
ang. grandiceps, Talbot, 129
ang. Lyellii, 129
ang. multilobum densum, Carbonell, 129
ang. parvissimum, 129
ang. Pateyii, 129
ang. pendens, Wills, 130
ang. perserratum, Patey, 130
ang. plumosum, Patey, 129
ang. plum., Wollaston, 129
ang. polydactylum, 130
ang. polyd. grande, 130
ang. polyd. splendens, 130
ang. proliferum, Allchinii, 130
ang. prol. Craufordianum, 130
ang. prol. densum, 130
ang. prol. Henleyæ, 130
ang. prol. Lyellii, 130
ang. prol. Wollastonii, 130
ang. pulcherrimum, Moly, 130
ang. pulch., Padley, 130, 159

Polystichum angulare pulch., Thompson, 130
ang. pulch. variegatum, Moly, 130
ang. pulch., Wills, 130
ang. ramo-furcillatum, 131
ang. revolvens, 131
ang. rotundatum, 131
ang. Thompsoniæ, 131
ang. tripinnatum, 131
Lonchitis, 125
L. cristatum, 125
Pot-culture, 30
Proliferation, 25, 31, 32, 150
Propagation, 31
Prothallus, 37
division of, 39
Pseudo-bulbils, 154
Pteris aquilina, 9, 11, 12, 13, 132
aq. congesta, 133
aq. crispa, 133
aq. cristata, 133
aq. glomerata, 133
aq. grandiceps, 133
aq. integerrima, 132
aq. polydactyla, 133
aq. ramo-cristata, 133
aq. vera, 132

R.

Red spider, 64
Replanting, 29
Repotting, 29
Revolute forms, 24
Rockwork, 51
Rogues, 12
Royal Fern (Osmunda regalis), 40, 113

S.

Saccharine, 8
Scolopendrium vulgare (Plate VII.), 9, 13, 14, 20, 24, 25, 28, 29, 42, 135; buds on, 32
Scolopendrium vulgare Baxterii, 137
v. bimarginato-cordatum, 136
v. capitatum, 137
v. capit., Forsteri, 137
v. cervi-cornu, 137
v. conglomeratum, 137
v. congl. densum, 137
v. Coolingii, 137
v. cornutum, 137
v. Cousensii, 138
v. corymbiferum, 137
v. crispum, 20, 23, 137
v. crispum, Bowden, 137
v. crispum, Clapham, 137
v. crispum diversifrons, 138
v. crispum fimbriatum, 138
v. crispum fimbriatum cristatum, 138
v. crispum, Gray, 137
v. crispum latum, 137
v. crispum majus, 137
v. crispum, Mrs. Stabler, 138
v. crispum multifidum, 138
v. crispum robustum, Stansfield, 137
v. crispum, Roundstone, 138
v. crispum sagittatum, 138
v. crispum, Wills, 137
v. cristatum, 138
v. crist., Keall, 138
v. crist., Millett, 138
v. crist. viviparum, O'Kelly, 138, 139
v. cristulatum, 137
v. digitatum, 140
v. endivæfolium, 140
v. fissum, 140
v. grandiceps, 140
v. hemionitioides, 140
v. inæquale furcans, 140
v. keratoides, 140
v. laceratum, 140
v. limbo-spermo cristatum, 140
v. Malcolmsonii, 141
v. marginatum, 140
v. marg. multiceps, 140
v. multifidum, 140
v. muricatum, 141
v. mur. inequale, 141

Scolopendrium vulgare peraferens, 141
v. polycuspis undosum, 141
v. ramo-cristatum, Clapham, 142
v. ramo-cristatum, Moly, 142
v. ramo-digitatum, 142
v. ramo-marginatum, 142
v. sagittato-cristatum, Dadds, 142
v. sagittato-cristatum, Hankey, 142
v. sagittato-projectum, Sclater, 142
v. sag.-proj., Westropp, 142
v. sag.-proj. variegatum, 142
v. spirale, 142
v. sp. ramosum, 142
v. subcornutum, 142
v. supralineatum, 142
v. transverso-lobatum, 143
v. undulato-rigidum, 138, 143
v. undulato-supralineatum, 143
v. undulatum, 143
v. unguiceps, 143
Seedlings, wild, 13
Selection, results of, 19
Serpentine forms, 24
Shield Ferns (Polystichum) (Plate VI.), 9, 22, 25, 28, 29, 124
Shield Fern, Hard Prickly (P. aculeatum), 125
Fern, Soft Prickly (P. angulare), 126
Slate shelves, 51
Slates, roofing and ridge, 46
pocket, &c., 47
Slugs and snails, 61
Species, how distinguished, 9
Spleenworts (Asplenium) (Plate II.), 28, 29, 76
Spleenwort, Black Maidenhair (A. Adiantum-nigrum), 77
Common (A. Trichomanes), 79
Forked (A. septentrionale), 83
Fountain (A. fontanum), 82
German (A. germanicum), 83
Green (A. viride), 81
Lanceolote (A. lanceolatum), 78
Spleenwort, Scaly (Ceterach officinarum), 28, 29, 84
Sea (A. marinum), 78
Spores, how to sow, 40
immense numbers of, 13, 34
Spore, wonders of the, 35
Sports, sudden, 19, 26
Sunny gardens, Ferns in, 53

T.

Thrips, 64
Todea superba, 59
Tree Ferns, 31, 34
Trichomanes radicans, 58, 147
radicans Andrewsii, 148
r. crispum, 148
r. dilatatum, 148
r. dissectum, 148
r. proliferum, 148
reniforme, 60
Truncate forms, 24
Tunbridge Fern (Hymenophyllum tunbridgense), 58, 59, 145

V.

Variation generally, 17
by jumps, 19, 26
Variegation, 24

W.

Wall-Rue (Asplenium Ruta-muraria), 83
Wall-tiles, Booty's, 51
Wardian cases, 58, 60
Watering, 30
West Ham Park, collection at, 4
White fly, 64
Woodlice, 63
Woodsia hyperborea, 144
ilvensis, 144

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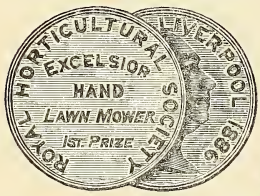

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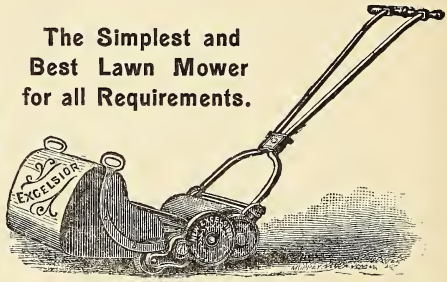

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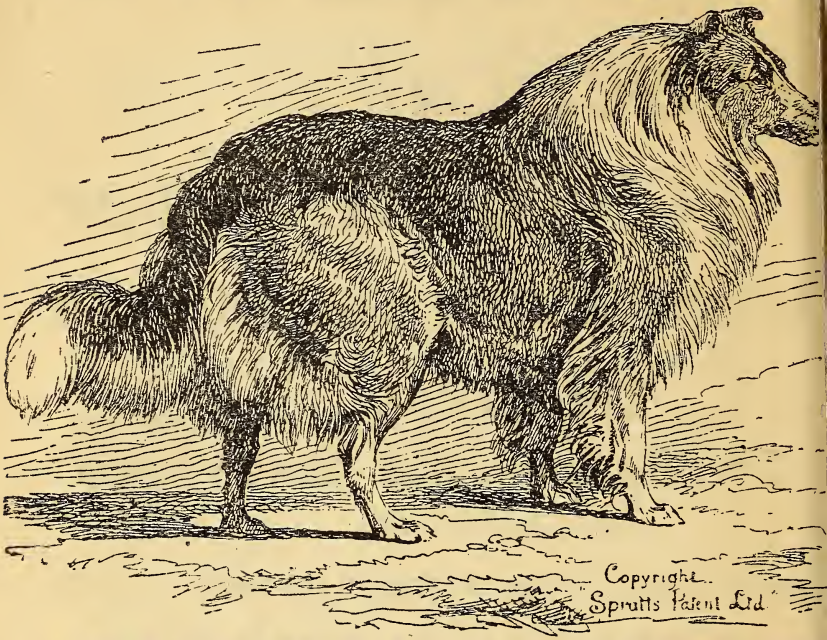

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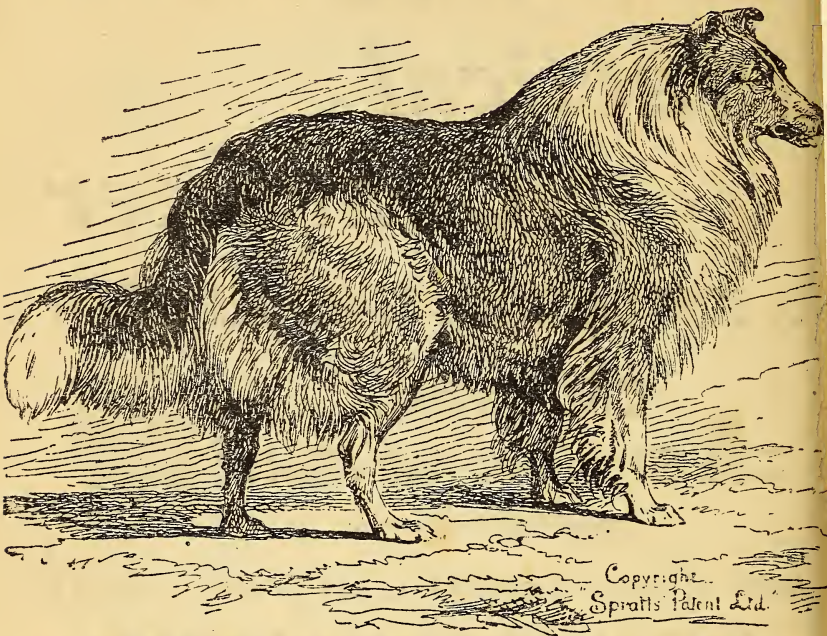

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